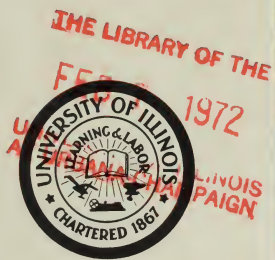


C  
IZ43Zg  
1971/72

~~Kef~~



GRADUATE STUDY | UNIVERSITY OF ILLINOIS AT CHICAGO CIRCLE | 1971-1972



CHICAGO CIRCLE  
BULLETIN



# Graduate Study

The University of Illinois

at

Chicago Circle

1971 - 1972

## CHICAGO CIRCLE BULLETIN

Volume 6

Number 4

August 15, 1971

Published by the University of Illinois Office of Publications, 2631 University Hall, 601 S. Morgan, Chicago, Illinois 60607. Issued monthly as follows: once in January, February, March, July, August, November, and December; twice in May and June; three times in April and October; four times in September. Application to mail at second-class postage rates is pending at Chicago, Illinois.



# Contents

Academic Calendar . . . . .	4
Board of Trustees . . . . .	8
Administrative Officers . . . . .	9
Departments Offering Graduate Work . . . . .	11
Campus History and Information . . . . .	15
Academic and General Regulations . . . . .	20
Tuition, Fees, and Other Charges . . . . .	27
Assistantships, Fellowships, and Financial Aid . . . . .	33
Campus Facilities and Student Services . . . . .	39
The Departments . . . . .	44
Additional Courses for Graduate Credit . . . . .	170
Additional Faculty of the Graduate College . . . . .	210
Index . . . . .	214

# Calendar of the Graduate College

1971-1972

## *Fall Quarter, 1971*

September 20-24 (Monday-Friday)	Registration week
September 27 (Monday)	Instruction begins
October 1 (Friday)	Last day to submit titles of Ph.D. theses
October 25 (Monday)	Veterans Day (no classes)
October 29 (Friday)	Last day for Graduate College format approval of Ph.D. theses for fall quarter
November 5 (Friday)	Last day to drop a course
	Last day to submit titles of master's theses
November 19 (Friday)	Last day for Graduate College format approval of master's theses for fall quarter
	Last day for addition of names to the fall quarter graduation list
November 25-26 (Thursday, Friday)	Thanksgiving vacation
December 3 (Friday)	Instruction ends
December 6-10 (Monday-Friday)	Final examinations

## *Winter Quarter, 1972*

December 13-17 (Monday-Friday)	Registration week
January 3 (Monday)	Instruction begins
January 7 (Friday)	Last day to submit titles of Ph.D. theses
January 28 (Friday)	Last day to submit titles of master's theses
February 4 (Friday)	Last day for Graduate College format approval of Ph.D. theses for winter quarter
	Lincoln Day (no classes)
February 7 (Monday)	Last day to drop a course
February 11 (Friday)	Last day for Graduate College format approval of master's theses for winter quarter
February 18 (Friday)	
February 25 (Friday)	Last day for addition of names to winter quarter graduation list
March 10 (Friday)	Instruction ends
March 13-17 (Monday-Friday)	Final examinations

*Spring Quarter, 1972*

March 20-24 (Monday-Friday)	Registration week
March 27 (Monday)	Instruction begins
March 30 (Thursday)	Last day to submit titles of Ph.D. theses
March 31 (Friday)	Good Friday (no classes)
April 7 (Friday)	Last day for addition of names to the spring quarter graduation list
April 21 (Friday)	Last day to submit titles of master's theses
April 28 (Friday)	Last day for Graduate College format approval of Ph.D. theses for spring quarter
May 5 (Friday)	Last day to drop a course
May 12 (Friday)	Last day for Graduate College format approval of master's theses for spring quarter
May 29 (Monday)	Memorial Day (no classes)
May 30 (Tuesday)	Memorial Day (classes will be held)
June 2 (Friday)	Instruction ends
June 5-9 (Monday-Friday)	Final examinations
June 18 (Sunday)	Commencement

*Summer Quarter, 1972*

June 12-16 (Monday-Friday)	Registration week
June 19 (Monday)	Instruction begins
June 23 (Friday)	Last day to submit titles of Ph.D. theses
July 4 (Tuesday)	Independence Day (no classes)
July 14 (Friday)	Last day to submit titles of master's theses
July 21 (Friday)	Last day for Graduate College format approval of Ph.D. theses for summer quarter
July 28 (Friday)	Last day to drop a course
	Last day for Graduate College format approval of master's theses for summer quarter
August 7 (Monday)	Last day for addition of names to the summer quarter graduation list
August 25 (Friday)	Instruction ends
August 28-September 1 (Monday-Friday)	Final examinations

## 1972-1973

### *Fall Quarter, 1972*

September 1-22 (Monday-Friday)	Registration week
September 25 (Monday)	Instruction begins
September 29 (Friday)	Last day to submit titles of Ph.D. theses
October 23 (Monday)	Veterans Day (no classes)
October 27 (Friday)	Last day for Graduate College format approval of Ph.D. theses for fall quarter
November 3 (Friday)	Last day to drop a course
November 17 (Friday)	Last day to submit titles of masters theses
	Last day for Graduate College format approval of master's theses for fall quarter
	Last day for addition of names to the fall quarter graduation list
November 23-23 (Thursday-Friday)	Thanksgiving vacation
December 1 (Friday)	Instruction ends
December 6-8 (Monday-Friday)	Final examinations

### *Winter Quarter, 1973*

December 11-15 (Monday-Friday)	Registration week
January 2 (Tuesday)	Instruction begins
January 5 (Friday)	Last day to submit titles of Ph.D. theses
January 26 (Friday)	Last day to submit titles of masters theses
February 2 (Friday)	Last day for Graduate College format approval of Ph.D. theses for winter quarter
February 5 (Monday)	Lincoln Day (no classes)
February 9 (Friday)	Last day to drop a course
February 16 (Friday)	Last day for Graduate College format approval of master's theses for winter quarter
February 23 (Friday)	Last day for addition of names to winter quarter graduation list
March 9 (Friday)	Instruction ends
March 12-16 (Monday-Friday)	Final examinations

### *Spring Quarter, 1973*

March 19-23 (Monday-Friday)	Registration week
March 26 (Monday)	Instruction begins
March 30 (Thursday)	Last day to submit titles of Ph.D. theses
April 6 (Friday)	Last day for addition of names to the spring quarter graduation list
April 19 (Thursday)	Last day to submit titles of master's theses
April 20 (Friday)	Good Friday (no classes)
April 27 (Friday)	Last day for Graduate College format approval of Ph.D. theses for spring quarter
May 4 (Friday)	Last day to drop a course
May 11 (Friday)	Last day for Graduate College format approval of masters theses for spring quarter
May 2 (Monday)	Memorial Day (no classes)

June 1 (Friday)  
June 4-8 (Monday-Friday)  
June 17 (Sunday)

Instruction ends  
Final examinations  
Commencement

*Summer Quarter, 1973*

June 11-15 (Monday-Friday)  
June 18 (Monday)  
June 22 (Friday)  
July 4 (Wednesday)  
July 13 (Friday)  
July 20 (Friday)

Registration week  
Instruction begins  
Last day to submit titles of Ph.D. theses  
Independence Day (no classes)  
Last day to submit titles of master's theses  
Last day for Graduate College format approval  
of Ph.D. theses for summer quarter

July 27 (Friday)

Last day to drop a course  
Last day for Graduate College format approval  
of master's theses for summer quarter  
Last day for addition of names to the summer  
quarter graduation list

August 6 (Monday)

August 24 (Friday)  
August 27-31 (Monday-Friday)

Instruction ends  
Final examinations

# The Board of Trustees

## of the University of Illinois

### Members Ex Officio

Richard B. Ogilvie, Governor of Illinois . . . . . Springfield 62706  
Michael J. Bakalis, Superintendent of Public Instruction . . Springfield 62706

### Elected Members

#### *1967-1973*

Donald R. Grimes . . . . . 1618 Orrington Avenue, Evanston 60201  
Ralph C. Hahn . . . . . 1320 South State Street, Springfield 62704  
Roger B. Pogue . . . . . 705 N. Oakland Avenue, Decatur 61801

#### *1969-1975*

Earl M. Hughes . . . . . 206 N. Hughes Road, Woodstock 60089  
Russell W. Steger . . . . . 135 S. LaSalle Street, Chicago 60603  
Timothy W. Swain . . . . . 411 Hamilton Boulevard, Peoria 61602

#### *1971-1977*

William D. Forsythe, Jr. . . . . 425½ E. Washington Street, Springfield 62701  
George W. Howard III . . . . . Howard Building, Box U, Mt. Vernon 62864  
Earl Langdon Neal . . 111 W. Washington Street, Suite 1525, Chicago 60602

### Officers of the Board

Earl M. Hughes, President . . . . . Woodstock  
Earl W. Porter, Secretary . . . . . Urbana  
Robert R. Manchester, Treasurer . . . . . Chicago  
Herbert O. Farber, Comptroller . . . . . Urbana



# Administrative Officers

## General University

President .....	John E. Corbally, Jr.
Executive Vice President and Provost .....	Lyle H. Lanier
Vice President and Comptroller .....	Herbert O. Farber
Vice President .....	Eldon L. Johnson
Secretary .....	Earl W. Porter
Director, University Office of School and College Relations .....	E. Eugene Oliver
Dean, University Extension .....	Stanley C. Robinson
University Counsel .....	James J. Costello
Director, Nonacademic Personnel .....	Oscar S. Smith
Director, Physical Plant Planning and Construction .....	
Director, Public Information .....	Charles E. Flynn
Executive Director, Alumni Association .....	James Vermette
Executive Director, University of Illinois Foundation .....	Joseph W. Skehen

## Chicago Circle

Chancellor .....	Warren B. Cheston
Vice Chancellor and Dean of Faculties .....	Daniel C. McCluney, Jr.
Assistant Chancellor .....	Robert P. Bentz
Dean of Student Affairs .....	Oscar Miller
Associate Administrative Dean .....	Harold N. Cooley
Dean, College of Architecture and Art .....	Leonard J. Currie
Dean, College of Business Administration .....	Irvin L. Heckmann
Dean, College of Education .....	Van Cleve Morris
Director, School of Physical Education .....	Sheldon L. Fordham
Dean, College of Engineering .....	George Bugliarello
Dean, Graduate College .....	Jan Rocek
Associate Dean .....	H. Fred Koeper
Associate Dean .....	William J. Otting
Assistant Dean .....	John A. Nicolette
Assistant to the Dean .....	Otis Dante
Dean, College of Liberal Arts and Sciences .....	Dean B. Doner
Associate Director, Jane Addams Graduate School of Social Work .....	George W. Magner

University Librarian . . . . .	William B. Ernst
Director, Business Affairs . . . . .	James E. Osborn
Legal Counsel (Campus) . . . . .	James E. Harmon
Director, Admissions and Records . . . . .	William C. Price
Director, University Honors Programs . . . . .	Samuel Schrage
Director, Personnel Services . . . . .	Leroy J. Votava
Director, Physical Plant, Chicago Campuses . . . . .	Frank W. Houck
Director, Auxiliary Services . . . . .	James J. Overlock
Director, Public Information, Chicago Circle . . . . .	Grover E. Shipton
Director, Chicago Circle Center . . . . .	Dale Brostrom
Commandant, R.O.T.C. . . . .	Lt. Col. John A. Hettinger, Jr.



# Departments Offering Graduate Work

## *Anthropology: M.A.*

Robert L. Hall, Chairman  
3102 Behavioral Sciences Building

## *Bioengineering: M.S. (See Information Engineering)*

Burt Zuber, Acting Head  
1128 Science and Engineering Offices

## *Biological Sciences: M.S.*

Elmer B. Hadley, Head  
3236 Science and Engineering South

## *Chemistry: M.S., Ph.D.*

Specializations in organic, inorganic, and physical chemistry.

William F. Sager, Head  
408 Science and Engineering South

## *Energy Engineering: M.S.*

Specializations in continuum and molecular fluid mechanics, heat and mass transfer, and macroscopic and microscopic thermodynamics.

James P. Hartnett, Head  
912 Science and Engineering Offices

The Ph.D. in Solids and Fluids is offered jointly by the Energy Engineering and Materials Engineering Departments. Specializations are offered in continuum mechanics, gas dynamics, heat transfer, metallurgy, plasma dynamics, soil engineering, and structures.

## *English: M.A.*

M.A. in English with a specialization in literature and creative writing.

M.A. in Linguistics.

John C. Johnson, Head  
2333 University Hall

## *Geological Sciences: M.S.*

Specializations in crystallography, mineralogy, petrology, and geochemistry; paleontology, oceanography, sedimentology, and sedimentary geochemistry.

Werner H. Baur, Head  
2460 Science and Engineering South

## *German: M.A.*

Specializations in German literature; German philology and linguistics.

Robert R. Heitner, Head  
1605 University Hall

## *History: M.A., Ph.D.*

Ph.D. specializations in Early Europe and Modern Europe, and British, Russian, French, Italian, and American history. M.A. specializations in ancient world, medieval Europe, early modern Europe, Russia, Great Britain, America (United States), Africa, imperialism and colonialism, and historiography.

Edward C. Thaden, Chairman  
1932 University Hall

*Information Engineering:* M.S.  
Specializations in information engineering and bioengineering.  
1112 Science and Engineering Offices

*Materials Engineering:* M.S.  
Specializations in metallurgy, soil mechanics and foundations, structures (including concrete technology), engineering mechanics.  
Ernest F. Masur, Head  
816 Science and Engineering Offices

*Mathematics:* M.A., M.S., M.S. in Teaching of Mathematics, Ph.D.  
Joseph Landin, Head  
322 Science and Engineering Offices

*Philosophy:* M.A., Ph.D.  
1803 University Hall

*Physics:* M.S., Ph.D.  
Specializations in atomic and molecular physics, high energy physics, nuclear physics, solid state physics, theoretical physics.  
Swaminatha Sundaram, Head  
2244 Science and Engineering South

*Political Science:* M.A.  
Specializations in American government, public administration.  
Richard M. Johnson, Head  
1102 Behavioral Sciences Building

*Psychology:* M.A., Ph.D.  
Harry S. Upshaw, Head  
1008A Behavioral Sciences Building

*Social Work:* M.S.W.  
There is also a joint program with McCormick Theological Seminary. For details, write directly to the School of Social Work.  
George W. Magner, Associate Director  
1322 University Hall

*Sociology:* M.A., Ph.D.  
Specializations in urban institutions and social psychology.  
Robert L. Hall, Head  
4118 Behavioral Sciences Building

*Speech and Theater:* M.A.  
Specializations in communication and public address and theater.  
R. Victor Harnack, Head  
4022 Behavioral Sciences Building

Graduate *courses* are offered in some departments that do not yet offer a degree program; they are available to all graduate students on an elective basis.

For additional information about programs listed in this catalog, correspond directly with the appropriate department at the listed address.

Graduate College  
1523 University Hall  
University of Illinois at Chicago Circle  
Box 4348, Chicago, Illinois 60680

## Executive Committee of the Graduate College

Jan Rocek, Ph.D., Dean of the Graduate College; Professor of Chemistry  
Maurice J. Eash, Ed.D., Professor of Education  
Brian Gluss, Ph.D., Professor of Quantitative Methods  
Elmer B. Hadley, Ph.D., Professor of Biological Sciences  
Noboru Ito, Ph.D., Professor of Mathematics  
Richard M. Johnson, Ph.D., Professor of Political Science  
John W. Johnstone, Ph.D., Associate Professor of Sociology  
Howard F. Koeper, Ph.D., Professor of History of Architecture and Art  
Jay A. Levine, Ph.D., Professor of English  
Nicholas Moravcevic, Ph.D., Associate Professor of Comparative Literature  
Chathilingath K. Sanathanan, Ph.D., Associate Professor of Information  
Engineering  
Paul W. Simon, M.S.S.A., Professor of Social Work  
Edward C. Thaden, Ph.D., Professor of History  
Otto E. Widera, Ph.D., Associate Professor of Engineering Mechanics  
Robert S. Wyer, Jr., Ph.D., Associate Professor of Psychology



# Campus History and Information

The University of Illinois at Chicago Circle was activated in 1965, not as a new institution but as the successor to the Chicago Undergraduate Division, through which the University of Illinois for 19 years provided the first two years of college and preprofessional work for over 100,000 commuting college students of the Chicago area.

In the spring of 1946 the University realized that men and women from the Armed Services could not be admitted to the main campus at Champaign-Urbana because it was impossible to construct additional facilities in time to meet the demand. Restricting enrollment was undesirable; therefore, Navy Pier, already used as a school and adaptable to the needs of a freshman-sophomore program, was leased by the Board of Trustees to organize the Chicago Undergraduate Division. That fall, 3800 students, three-fourths of them veterans, were enrolled. Although the percentage of veterans dropped slightly in 1947, enrollment rose above 4500.

In January, 1961, the Board of Trustees approved the granting of baccalaureate degrees by the Chicago Undergraduate Division as soon as an adequate campus was available: the site, where the Eisenhower, Ryan, and Kennedy Expressways converge, was selected in 1961, the Chicago Undergraduate Division became the University of Illinois at Chicago Circle, and the campus was occupied on February 22, 1965.

The first thirteen graduate programs were established in September, 1967. At the beginning of the 1971-1972 academic year the University of Illinois at Chicago Circle offers master's degrees in eighteen fields and doctor's degrees in eight.

Other University of Illinois facilities in Chicago are at the Medical Center, which houses the Colleges of Medicine (including the School of Associated Medical Sciences), Dentistry, Nursing, and Pharmacy and the Health Sciences Division of the Graduate College.

## Location and Transportation

The Chicago Circle campus is located just south and west of the Loop in an area bounded by the Eisenhower and Ryan Expressways, Racine Avenue,



and Roosevelt Road. The mailing address is Box 4348, Chicago, Illinois 60680. Transportation to the campus is by way of the CTA, which has built a station at Peoria Street especially to serve Chicago Circle, and by the buses on Halsted, Harrison, and Taylor Streets and on Roosevelt Road.

## Admission

The academic year at Chicago Circle consists of three 11-week quarters (including the final examination periods) that begin in September (fall quarter), January (winter quarter), and March (spring quarter). The 11-week summer quarter begins in June. A student may seek admission to any one of the four quarters; however, the scheduling in many departments makes it desirable that students enter in the fall quarter.

The minimum requirements for admission to the Graduate College are:

1. A baccalaureate degree from an accredited institution.
2. Recommendation for admission by the department to which application is made and by the Dean of the Graduate College.
3. A cumulative grade-point average of 3.500 (A=5.000), which is computed on the last 90 quarter hours (60 semester hours) of undergraduate work. An applicant for post-master's work and a doctoral candidate who has earned a master's degree or has completed at least 48 quarter hours (32 semester hours) of graduate study at an accredited institution are *also* considered for admission on the cumulative grade-point average for the graduate work completed.

Some departments have adopted requirements higher than the minimum. For specific department requirements for the average required, the completion of the Graduate Record Examination, required undergraduate subjects, and additional information, consult the appropriate section of this catalog.

The Graduate College may, when space permits, recommend the admission of an unassigned student so that specific educational goals of individuals may be realized. For the same reason, after consultation with the department concerned, the Graduate College may recommend the admission of a student on a non-degree status. Such admission does not commit the University for more than one quarter at a time nor is any commitment implied that any non-degree or unassigned student will be accepted into a degree program at a later date. Credit earned as a non-degree or unassigned student may be counted toward a degree only with the express consent of the department and the Dean of the Graduate College.

## Graduate Study by Seniors at the University of Illinois at Chicago Circle

Upon recommendation of the department, an undergraduate student may be given graduate credit for graduate courses taken in his senior year. However, these courses may *not* be applied toward the baccalaureate degree.

## Application Procedures

Applications for admission may be obtained from the Office of Admissions and Records, the departments, or the Graduate College Office (see page 11). A prospective student should apply for admission at least two months before the beginning of the quarter in which he wishes to enroll. All applications must be accompanied by the nonrefundable application fee of \$15. Applications will be reviewed only when all official transcripts and other required credentials have been received by the Office of Admissions and Records and forwarded to the appropriate department.

## Foreign Applicants

Persons who have completed their studies outside the United States must present all post-secondary school credentials. Such credentials must include a record of all studies completed to date, grades or examination results received (including failing as well as passing grades), maximum and minimum grades obtainable in the school, rank in class, degrees, diplomas, and certificates earned, and length of the school year. *Documents must be authentic or certified, and those not written in English must be accompanied by certified English translations.*

Applicants whose native language is not English will be required to take the Test of English as a Foreign Language (administered by the Educational Testing Service, Box 899, Princeton, New Jersey 80540).

All foreign applicants who plan to finance their study at the University of Illinois from personal resources must certify that they will have sufficient funds to cover their expenses. Obtain the appropriate form from the Office of Admissions and Records.

Foreign students granted admission will receive from the Office of Admissions and Records all appropriate documents, including the certification forms that are used in applying for visas to enter the United States.

## Application Deadlines

There is no official deadline for graduate applications. However, the number of graduate students who can be admitted is limited and applications are processed in the order in which they are received. Admission consideration will cease when capacities are reached; therefore, it is in the best interest of the applicant to submit his application and supporting credentials as early as possible.

## Readmission

A student who did not complete in the Graduate College the quarter immediately preceding the one in which he wishes to enroll, *and* who had not received approval for Off-Quarter Vacation or Leave of Absence, must submit an application for readmission. This rule does not apply to a student registering for the fall quarter if he was registered during the spring quarter. Such applications should be submitted no later than two weeks before the beginning of the quarter to which readmission is sought and must be accompanied by the \$15 nonrefundable application fee.

## Nonrefundable Deposit

A nonrefundable deposit of \$30 is required of all applicants approved for admission or readmission to a fall quarter. *The deposit should not be sent until it is requested by the Office of Admissions and Records*; it is applied toward tuition for the first quarter in which the student enrolls. Graduate students assured of the award of a fellowship, assistantship, or tuition-and-fee waiver are exempt from paying this deposit.

## Registration

Newly admitted and readmitted graduate students are sent a Permit to Enter and complete registration instructions. Registration may not be completed without the Permit to Enter. Students admitted to the University of Illinois for the first time are required to take a medical examination prescribed by the University Health Service. This examination must be administered by the student's physician at the student's expense. Instructions and required forms are mailed by the University after admission approval.

## Leave of Absence

A Graduate College student may be granted a leave of absence for not more than four quarters. Such leave of absence must be approved by the Dean of the Graduate College prior to the end of the quarter before the leave is requested. Petition forms are available in the department and Graduate College offices. Approved petitions will be filed with the Office of Admissions and Records, which will mail instructions and registration materials for the quarter in which the student-on-leave is expected to enroll.



## Off-Quarter Vacations

A student may elect to attend any three quarters in one calendar year. If he chooses to use a quarter *other than the summer* as his vacation or Off Quarter, he must file an application with the Office of Admissions and Records before the first day of instruction of the quarter he wishes to use as vacation. Application blanks are available in that office. If the vacation quarter is other than the summer quarter, the student must attend the summer quarter of that calendar year if he wishes to retain his status as a continuing student.

The student approved for an Off-Quarter Vacation is entitled to the same privileges as continuing students. He may make arrangements with the Insurance Office to carry his hospital-medical-surgical insurance, and he may advance enroll. Registration cards and information are mailed to him by the Office of Admissions and Records.

# Academic and General Regulations

A student should familiarize himself with the academic requirements and regulations of the Graduate College and of the department in which he is working. He is responsible for complying with these regulations and for fulfilling all requirements for his particular degree. Every graduate student should have a Graduate College catalog and, if available, a department brochure, for they are official statements of policy. The usual procedures and requirements of the Graduate College are indicated in this catalog.

## Petitions

A student may petition the Dean of the Graduate College for exceptions to any of the following regulations, but he should do so only after consultation with his adviser and the department coordinator of graduate studies. Forms for such petitions may be secured from the Graduate College.

## Work Completed Elsewhere

Unless the department specifies otherwise at the time of admission a doctoral candidate who has received a master's degree from an accredited institution will receive 48 quarter hours of credit toward the minimal 144 quarter-hour requirement for the doctoral degree; a petition is not required. A student who has completed, in an accredited institution, graduate work for which a degree was not awarded may petition for credit toward an advanced degree. After consultation between the student and his adviser, the department shall submit to the Graduate College its recommendations, which should include the courses required for transfer, those allowed (including the number of quarter hours of credit recommended) those disallowed, and grades and certification from the registrar or the college dean of the applicable institution that the courses are graduate level and were not used toward fulfillment of the requirements for a degree. The number of credits that may be transferred is determined on an individual basis. (Such credit does not reduce residency requirements.) Six quarter hours are the equivalent of four semester hours (or at the Urbana campus, one semester unit of graduate credit).

## Time Limitations for Advanced Degrees

A candidate for a master's degree must complete all requirements for the degree within four calendar years after his initial registration in the Graduate College. Doctoral candidates must complete their degree requirements within six years after receiving the master's degree or its equivalent. In special circumstances the student, after consultation with his adviser, may petition the Graduate College and his department for an extension of this time limit.

## Advisers

Each graduate student must have an adviser in the department in which he is a degree candidate. The adviser assists in planning a program of graduate study that fits the needs of the student and satisfies department and Graduate College requirements. A new student should contact his major department to discuss the selection of an adviser. Many departments have a coordinator of graduate studies whose responsibilities include direction of all graduate work in that department.

## Courses of Instruction

Courses open to graduate students are of two types. Those numbered from 300 to 399 are open to advanced undergraduate and graduate students. Those numbered 400 to 499 are generally open only to graduate students. Some 300-level courses are available for graduate credit in departments other than those offering advanced degrees. Students should consult their advisers about the possibility of using these courses as minors.

A number of courses carry variable credit. At the 300 level, additional work, in the nature of special reports, papers, or projects, is required of a student who registers for the maximum credit allowed. At the 400 level, some research, reading, and independent courses provide variable credit; proportionate time devoted to a particular activity can thus be indicated on the student's record.

*Prerequisites.* Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

*Program Changes:* A student has the option of dropping a course until the end of the sixth week of the quarter. Thereafter a course may not be dropped. However, holders of fellowships, tuition-and-fee waivers, and student visas must maintain the required number of credit hours.

*Grading System:* Final grades for courses are recorded as A, B, C, D (lowest passing grade), and E (failure) with numerical computations of grade-point averages based on a system of A=5.000. Other symbols in use, but not included in the computation of grade-point averages are:

- W— Officially withdrawn from the course without penalty.
- IN— Incomplete. An IN must be removed by the end of the student's second quarter in residence subsequent to that in which it was received, or if he is not in residence, by the end of the first calendar year subsequent to that in which the IN was received. An IN that is not removed by the deadline will be changed automatically to a grade of IN/E.
- DF—Grade temporarily deferred. At the end of a continuing course sequence the deferred grade of DF for all quarters must be converted either to a specific letter grade or to an IN. Deferred grades should be used only for 499 (Thesis Research) courses, for other research, continuing seminar, or sequential courses, and for independent study.
- S— Satisfactory and
- U— Unsatisfactory. To be used only as the final grade in graduate thesis research courses, in graduate and undergraduate courses that carry zero credit hours, and in other courses that have been specifically approved.
- P— Pass and
- F— Fail. To be used only in courses taken under the pass-fail grading option. A graduate student may take courses on a pass-fail basis provided that:
  1. The courses are not within the student's immediate area of specialization.
  2. Such courses account for no more than one-sixth of the total number of course hours taken at the University of Illinois at Chicago Circle and counted toward a degree.
  3. The student declares his intention to take a course on this basis at the time of registration.

## Probation and Drop Rules

A student may be dropped by the Graduate College upon recommendation of the department. If a student's cumulative average for courses taken for credit falls below 3.500 at the end of any quarter, he will be placed on probation. If the cumulative average remains below 3.500 at the end of the academic year (or at the end of three quarters) the student will be dropped from the Graduate College. Departments may set higher standards. An average of 3.500 or better is required for graduation.

## Course Loads

Graduate students who are not employed are generally advised to carry no more than 16 quarter hours of credit, although up to 20 hours of course



credit are permissible in exceptional cases with consent of the Graduate Student Coordinator. It is recommended that students who hold part time employment outside the University reduce their loads to the limits for teaching assistants, given below.

*Fellowship holders:* Fellowships are awarded to superior students; therefore, fellowship holders are required to carry a minimum of 16 quarter hours of credit.

*Graduate College tuition-and-fee-waiver holders:* Students awarded special Graduate College tuition-and-fee waivers must carry a program of 12 quarter hours.

*Assistants:* The academic work carried by assistants and others on the University staff is limited by statute. For a graduate student who holds an assistantship, the limits are as follows:

<i>Appointment</i>	<i>Maximum hours per quarter</i>
Full	4
3/4	8
2/3	9
1/2	12
1/3	15
1/4	16

*Minimum full time study.* For purposes of enrollment certification to the United States Department of Justice, Immigration and Naturalization Service the Graduate College considers a student to be pursuing a minimum full time program of study if he takes: (1) 12 or more quarter hours of graduate credit, or (2) a program of both graduate and undergraduate courses equivalent to 12 quarter hours of credit, or (3) 10 quarter hours of graduate study plus an appointment for not less than 1/3 time, or (4) 8 quarter hours of graduate study and an appointment as a teaching or research assistant for not less than 1/2 time. However, a veteran is to be eligible for full veterans benefits, he must be registered for at least 12 quarter hours credit each quarter.

## Auditing Privileges

A graduate student regularly registered may be permitted to attend classes as an auditor without credit at the discretion of the instructor in charge of the course. Students who wish to have their audited courses recorded must pay the Course-Visitor Auditor Fee (see Tuition and Fees). Persons not registered at the University of Illinois are permitted to attend classes, other than laboratory courses, as auditors, provided they pay the fee and file with the Office of Admissions and Records a permission form bearing the approval of the instructor and the Dean of the Graduate College. A student should not enter on his program card any courses he plans to attend as an auditor.

## Regulations Pertaining to Degrees

### The Master's Degree

*Residence:* Twenty four hours of work, including not more than 12 hours in courses titled Independent Study and Thesis Research, must be taken within two calendar years.

The following are the requirements of the Graduate College only; department requirements are in addition to them. A minimum of 48 quarter hours is required for the master's degree. At least 16 of the 48 quarter hours must be in courses numbered 400 and above, and 12 of these 16 must be in the major field. At least 24 quarter hours must be taken in the major field of interest; the remaining credit may be in the field or in other courses appropriate to the student's educational goals. No more than 18 quarter hours of credit in 499, Thesis Research, may be included in a 48-hour program.

Twenty-four quarter hours (which may include Thesis Research) must be earned at the University of Illinois at Chicago Circle. Exceptions may be granted by the Graduate College upon recommendation of the department.

*Examinations for the master's degree.* If an examination is required, its structure is determined by the department. If a master's thesis is presented, the candidate shall defend it before a committee appointed by the Dean of the Graduate College on the recommendation of the department. This committee shall consist of at least three persons<sup>1</sup>, one of whom must have permanent membership. The approval of the thesis by a majority of the committee is required.

*Thesis.* A student electing or required to write a master's thesis should file the title of the thesis with the Graduate College at least six weeks prior to graduation. No more than 18 quarter hours of thesis credit may be included in a 48-quarter-hour program. Credit in thesis research cannot be applied to a degree until the thesis is accepted. For specific instructions on the format of the thesis the student should obtain a copy of the leaflet, "Instructions for Preparation of Theses," from the Graduate College Office, 1523 University Hall.

### The Doctoral Degree

*Residence:* At least 12 hours beyond the master's level or its equivalent must be taken at Chicago Circle in regularly scheduled courses (excluding Independent Study and Thesis Research) within one calendar year. Three consecutive quarters of at least 8 hours (which may include Thesis Research) must be taken at Chicago Circle.

<sup>1</sup>One member of the committee may be from outside the department or from outside the University.

The general requirements for this degree are stated below; any special requirements are given in the departmental listings.

Each student's schedule of course work and research (a total of 144 quarter hours of credit beyond the bachelor's degree) is planned in consultation with his adviser with consideration given to the candidate's previous training, his career objective, the general regulations of the Graduate College, and any specific departmental requirements. It is the student's responsibility to be aware of these regulations and requirements and to satisfy them as early as possible. The major area of specialization consists of a selection of courses closely related to each other, not all of which are necessarily offered by the major department. If a student elects or is required by departmental regulations to declare a minor outside his major department, the selection of courses must be approved by the departments or divisions concerned. A minor area of specialization consists of a group of course offerings that have a distinct relationship, though they may be offered in more than one department.

Except in special cases, teaching is required of each graduate student as a part of his professional growth and development.

*Foreign Language Requirement.* The foreign language requirement for the degree of Doctor of Philosophy is left to the individual department, division, or jointly administered program, subject to the approval of the Graduate College.

*Examinations.* The Graduate College requires two examinations; a committee will be appointed for each. The first examination, called the preliminary, is an examination of the candidate's grasp of the field of his major (and minor) subjects. The second is an examination on the candidate's dissertation. The department may have additional requirements. The committee for the preliminary examinations shall consist of at least five persons representing the major and minor areas.<sup>1</sup> Members of the committee will be appointed by the Dean of the Graduate College on recommendation of the department. At least two of these members must have permanent membership on the Graduate Faculty.

The preliminary examination may be written, oral, or both at the discretion of the department. The timing is also at the discretion of the department. The recommendations of the department, including the action of the committee, shall be reported to the Graduate College. Part of the report will be a summary of the votes of the committee members. The total vote shall be pass, conditional (specified), or fail. A candidate may not be passed if he receives more than one vote of fail. When there is no unanimity, the Graduate College will act as arbitrator. The Dean, in consultation with the department head and the committee chairman, may allow the candidate to be given a second examination at some later date. The second committee may consist of the same examiners. No more than two preliminary examinations may be given.

<sup>1</sup>One member of the committee may be from outside the department or from outside the University.



The dissertation committee<sup>1</sup> shall follow the foregoing regulations except that the minimum membership shall be three. Two of these members must have permanent membership on the Graduate Faculty.

*Thesis.* The degree of Doctor of Philosophy is primarily a research degree and the candidate must demonstrate his capacity for independent research by the presentation of an original thesis on a topic within his major field of study. The subject of the thesis must be reported to the doctoral committee and to the Graduate College at the time of the preliminary examination. The candidate must register each term, except summer quarters, until he receives his degree. After satisfying the minimum credit requirement (144 quarter hours of courses and thesis research beyond the bachelor's degree) the student maintains his status as a candidate by registering for a full load of credit hours in 499 (Thesis Research) until his dissertation has been accepted. In cases where this imposes financial hardship or where the student is not making any use of University facilities or staff time, the student may request Graduate College permission to register for zero credit in 499.

Candidates engaged in thesis research may find it desirable or expedient to publish prior to the conferring of the degree certain findings that later will be incorporated in the dissertation. In this case, appropriate acknowledgment of the earlier publication should be included in the dissertation. The Graduate College encourages such publication, but the thesis in its entirety may not be published before all degree requirements have been completed. Directions regarding the format of the thesis are given in the leaflet, "Instructions for Preparation of Theses," which may be obtained in the Graduate College office. The candidate must submit to the Graduate College office, no later than the date specified in the current calendar of the College, the original and first carbon copy (or two copies reproduced by an approved method) of his thesis and one typewritten copy of an abstract not exceeding 600 words. Each candidate who passes the final examination must pay a \$25 microfilm fee. This provides for microfilming the complete thesis, with one copy deposited in the University of Illinois Library, and publication of the abstract in *Dissertation Abstracts*.

<sup>1</sup>One member of the committee may be from outside the department or from outside the University.



# Tuition, Fees, and Other Charges

All students are assessed tuition and fees which are payable in full as part of registration. Arrangements to defer payment under special circumstances may be made with the Business Office. The amount of tuition and the service fee vary with the number of credit hours for which the student registers. Tuition (but not the service fee) also varies according to the resident or nonresident status of the student in the State of Illinois.

In planning to meet financial requirements for the academic year 1971-1972, students should be aware that tuition rates at State universities will not be finally known until budgets are approved for that period by the General Assembly. The Board of Higher Education has undertaken a study of tuition charges and financial-aid programs and is expected to make recommendations to the Governor and the General Assembly for consideration in the budgetary deliberations during the next legislative session.

## Tuition and Fees—Chicago Circle (Subject to Change)

	Range I 10½ quarter hours and above		Range II 5½ through 10 quarter hours		Range III 0 through 5 quarter hours		Range IV 0 credit only Resident and Nonresident
	Res.	Nonres.	Res.	Nonres.	Res.	Nonres.	
Tuition (except those holding exemptions)	\$132	\$418	\$ 92	\$287	\$ 50	\$157	\$25
Service Fee	32	32	24	24	14	14	7
Hospital-Medical- Surgical Insurance Fee	7	7	7	7	7	7	7
Total	\$171	\$457	\$123	\$318	\$ 71	\$178	\$39

*Tuition and Fee Deposit.* The University requires a nonrefundable \$30 advance deposit, payable when an applicant receives notice of admission. This

deposit reserves the applicant a place only in the session to which he has been admitted. It is applied to his tuition and fees for that quarter; it cannot be applied to any subsequent quarter should he fail to enter in the quarter to which he has been admitted.

*Residence Classification.* The residence classification of an applicant is determined on the basis of information given on his application and other credentials. Fees are assessed in accordance with this decision. If the student believes he has a legitimate cause for change of status, he may petition for a change on a form provided by the Office of Admissions and Records. Petitions are considered *within thirty days* from the date designated in the official University Calendar as that upon which instruction begins for the academic period for which the fee is payable. However, if the nonresident tuition was not assessed on or prior to that date, the claim for refund may be filed *within thirty days* after the nonresident fee was assessed and the student was given notice of its assessment. Additional evidence to substantiate a request may be required. If the student expects to ask for a change of residence classification, it is advisable for him to request that the adjustment be made prior to the registration period.

In the event a student who claims he is a resident is dissatisfied with an adverse ruling of the Director of Admissions and Records, he may obtain a review of such decision by the Legal Counsel of the University by filing a written request with the Director of Admissions and Records within twenty days after he has been notified of the ruling.

Further information concerning residency may be secured from the Director of Admissions and Records. A brochure entitled *Regulations Governing Assessment of Resident or Nonresident Student Fees* is also available.

## Exemptions and Assessments

A student may be exempted from one or more of the following charges if he qualifies under the stated conditions:

*Tuition* is waived for:

1. Holders of tuition-waiver scholarships.
2. All academic employees of the University or allied agencies on appointment for at least 25 percent but not more than 67 percent of full-time service.
3. All permanent nonacademic employees of the University or allied agencies on appointment for at least 25 percent of full time who register in University courses in Range II or III.
4. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
5. Holders of grants or contracts from outside armed forces of the United States who are stationed and

6. Teachers and administrators who cooperate in the practice teaching program. (Exemption is allowed for each quarter of assignment within the same calendar year—September through August.)
7. Persons registered in noncredit seminars only.
8. University employees registered at the request of their departments in noncredit courses especially established to improve the work of the employee.
9. Academic staff members emeriti.

*The nonresident portion of tuition* (if the enrollee is subject to payment of tuition) is waived for:

1. All staff members (academic, administrative, or permanent nonacademic) on appointment for at least 25 percent of full time with the University or allied agencies.
2. The faculties of state-supported institutions of higher education in Illinois.
3. The teaching staff in private and public elementary and secondary schools in Illinois.
4. The spouses and dependent children of those listed in items 1 and 2. (Dependent children are those who qualify as dependents for federal income tax purposes.)
5. Persons actively serving in one of the Armed Forces of the United States who are stationed and present in the State of Illinois in connection with that service.
6. The spouses and dependent children of those listed in item 5, as long as they remain stationed, present, and living in Illinois.

For fee assessment purposes, a staff appointment must be for not less than three-fourths of the term. This is interpreted as a minimum of nine weeks in a quarter. Staff tuition-and-fee privileges do not apply to students employed on an hourly basis in either an academic or nonacademic capacity or to persons on leave without pay.

For fee assessment purposes, a permanent nonacademic employee is defined as a person who has been assigned to an established, permanent, and continuous nonacademic position and who is employed for at least 25 percent of full time. University employees appointed to established civil service positions whose rate of pay is determined by negotiation, prevailing rates, or union affiliation are entitled to the same tuition-and-fee privileges accorded other staff members under the regulations.

A student who resigns his staff appointment, or whose appointment is cancelled before he has rendered service for at least three-fourths of the term, becomes subject to the full amount of the appropriate tuition and fees for that term unless he withdraws from his University classes at the same time the appointment becomes void, or unless he files clearance for graduation within one week after the appointment becomes void.

## Fees

*The Service Fee* is applied toward the operating expense of Chicago Circle Center, the financing of the Center building, and the cost of the Student Activities Program.

The service fee is waived for:

1. All staff members of the University or allied agencies who are on appointment for at least 25 percent but not more than 67 percent of full time.
2. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
3. Students registered *in absentia*.
4. Students registered in courses taught off campus.
5. Holders of grants or contracts from outside sponsors if the service fee is charged to the contract or to grant funds.
6. Cooperating teachers and administrators described under *Exemptions*, item 6.
7. Persons registered in noncredit seminars only.
8. University employees, registered at the request of their departments, in noncredit courses for the purpose of improving their work.
9. Emeriti.

*The Course-Visitor-Auditor Fee* of \$15 is assessed all class visitors who are not in Range I in the tuition-and-fee schedule.

*The Late-Registration Fine* of \$15 is levied against all students who complete registration after classes have begun.

*The Hospital-Medical-Surgical Insurance Fee* is the same for all students, regardless of the number of hours for which they are enrolled or of their Illinois residence status. All students enrolled and in attendance at Chicago Circle are covered by a health insurance policy, for which they pay a fee each quarter at registration. Eligible dependents of insured students (spouse and/or unmarried dependent children under nineteen years of age) may also be insured if the student makes application to the University Cashier (Room 406, University Hall) within the time specified by the insurance policy.

If a student withdraws from the University, he does not receive an insurance fee refund since he remains insured for the balance of the quarter from which he withdrew. Special provisions exist for students to be covered by this insurance during the summer months, irrespective of their registration for that part of the year. For further information, consult the Insurance Office, Room 427, University Hall.

If a student presents evidence of insurance in force which provides him equivalent coverage, he may petition the University Insurance Office for a refund of this fee. Refunds are not made on any other basis. The student



should also consult the Insurance Office about the time limit for such a refund petition.

*The Deferred-Fee Charge* of \$2 is assessed when arrangements have been made with the Office of Business Affairs to defer payment of fees. The charge must be paid on the day the agreement is reached and is nonrefundable.

*The Lost-Photo-Identification-Card Fee* of \$1 is assessed for replacing a lost or destroyed Photo-Identification Card, issued to the student at the time of his first registration at Chicago Circle. Cost for replacing the current Student Fee Receipt Card is 50 cents.

*The Transcript Fee.* A student is issued one transcript of his record without charge. For each additional transcript, a fee of \$1 is assessed.

## Refunds

Students who withdraw from the University or from a course are entitled to a refund of a portion of the tuition and fees, if they have been paid, under the following circumstances.

*On Withdrawal from the University:* The full amount of tuition and fees assessed, *except for a \$31 nonrefundable charge*, is refunded to students who withdraw *within the first ten days* of instruction in a quarter. After the tenth day of instruction and before the middle of the quarter, one half of the amount assessed, *except for a \$31 nonrefundable charge*, is refunded. No refund is issued after midquarter.

No refund is issued if the total assessment was less than \$31 (for example, a student on a tuition-waiver scholarship).

The calendar in the quarterly Timetable indicates the dates on which the above regulations are effective.

*On Withdrawal from a Course:* If such withdrawal results in a reduction in the student's program to a lower tuition-and-fee range, the full difference is refunded during the full-rebate period; half the amount of the difference is refunded when withdrawal occurs during the half-rebate period; no refund is made if withdrawal occurs thereafter.

*On Withdrawal by a Visitor-Auditor:* A full refund will be issued if the withdrawal is made within ten days after payment of fees. Thereafter, no refund will be made.

*On Withdrawal to Enter Military Service:* If withdrawal occurs during the first six weeks of instruction, the student is entitled to a full refund of his tuition and fees, less the Hospital-Medical-Surgical Insurance fee. If with-

## 32 TUITION, FEES, AND OTHER CHARGES

drawal to enter military service occurs between the fifth and eighth weeks of instruction, the student will receive a one-half refund of his tuition and fees (less the Hospital-Medical-Surgical Insurance Fee). When withdrawal occurs after the fifth week of instruction, under certain circumstances, the student may receive partial or full credit in some of the courses in which he is registered at the time of the withdrawal. Further information is available in the Graduate College, 1523 University Hall.

No refund of tuition and fees is made after the eighth week.

# Assistantships, Fellowships, and Financial Aid

Various types of financial assistance are available each year to promising students in all fields of study in the Graduate College. For the most part, the information in this section deals with aid administered by the University of Illinois. It should be noted, however, that there are also a number of nationally sponsored fellowships that provide support for graduate students for study either at the University of Illinois or elsewhere. Among these are the National Science Foundation fellowships and the Woodrow Wilson fellowships. Other fellowships are offered through foundations, industrial concerns, and individuals. Further information and application procedures for nationally sponsored fellowships may be obtained by writing directly to the agency concerned or, in most instances, to the University department in which the student plans to major.

The University of Illinois at Chicago Circle offers five basic types of financial aid for graduate students: fellowships, assistantships in both teaching and research, tuition-and-fee waivers, loans, and employment. Each type of assistance is described in the following sections. In the operation of these programs and in selecting individuals for participation in and for administration of the programs, the University of Illinois will not discriminate on the grounds of race, creed, color, or national origin of any applicant or participant.

## Fellowships

Fellowship stipends are gratuities awarded in recognition of scholarly achievement and promise. They enable a student to pursue his graduate studies and research without requiring him to render any service. The stipends of different fellowships vary, but with few exceptions they are currently not less than \$1800 for the nine-month academic year. The fellow's stipend is legally regarded as a gift, not as compensation for services rendered, and is, therefore, exempt from income tax. Unless explicitly stated otherwise, all fellows whose appointments are administered by the Graduate College are exempt from tuition and fees. A fellow is required to pursue a full program of graduate study (at least 16 quarter hours per quarter) and may not engage in remunerative employment, other than an assistantship for University Fellows, without the permission of the Dean of the Graduate College.

*University Fellowships* are awarded on the basis of an all-campus competition and are not restricted to any particular field of graduate study listed in this Catalog. University Fellowships are for nine months and carry a stipend of not less than \$2,000 plus exemption from tuition and all regular fees except the Hospital-Medical-Surgical Insurance fee.

A student receiving a University Fellowship is also eligible to accept a part-time assistantship up to a maximum of one-quarter time. Under such an appointment, the fellow's basic stipend remains unchanged and tax-free, but the salary for teaching or research is generally subject to income tax. University Fellows who also hold an assistantship must carry full programs of graduate study (at least 16 quarter hours per quarter) unless expressly authorized by the Dean of the Graduate College to carry reduced programs. Students whose first interest is in teaching should so indicate on their applications.

*Industrial, Endowed, and Special Fellowships.* Various industrial firms, foundations, and private individuals have generously donated funds to support a number of special fellowships for graduate students at the University of Illinois. The stipends and supplemental allowances of these fellowships are not uniform, and most of them are restricted to students in particular areas of study. Further information may be obtained from the department in which the student plans to register.

*National Science Foundation Traineeships.* Under this program, grants are made directly to the participating institutions, which select promising individuals for full-time graduate study. Appointments may be made only from among citizens of the United States (or native residents of a United States possession) who are enrolled in programs leading to an advanced degree in the mathematical, physical, medical, biological, and engineering sciences, anthropology, economics, the history and philosophy of science, linguistics, political science, psychology, and sociology. Also included are the interdisciplinary areas which comprise overlapping fields among two or more sciences (for example, geochemistry, meteorology, and oceanography).

Trainees must devote full time to programs leading to advanced degrees and may be appointed for either nine or twelve months. A school may require or permit a trainee to include in his training program teaching which contributes to his academic progress.

The basic stipend for a twelve-month award is \$2,400 for the first year, \$2,600 for the intermediate year, and \$2,800 for the terminal-year level. An allowance of \$500 is granted for each dependent. For nine-month awards, the allowance is prorated. Inquiries concerning traineeships should be directed to the department of the University in which the student is seeking a traineeship.



## Assistantships

The various departments of the University employ graduate students as either teaching assistants or research assistants. The duties of a teaching assistant usually involve such activities as classroom instruction, supervision of a laboratory section, the guidance of discussion sections, and paper grading. Research assistants participate in research activities under the supervision of University faculty members. In some instances the work of a research assistant may be related to his thesis research; in others it may be entirely different. Although most research assistantships are awarded to graduate students who have completed one or more quarters of graduate work at the University of Illinois, new students are eligible for such appointments. Each assistant is paid a salary for services rendered, and, under present ruling, this salary generally is subject to income tax.\* Assistants holding more than one-fourth-time appointments are normally not permitted to carry full programs of graduate study during the period of their appointments.

Nature of Appointment	Maximum Registration per Quarter	Expected Clock Hours of Service per Week
Quarter Hours		
Full time	4	37½
Three-fourths time	8	29
Two-thirds time	9	25½
One-half time	12	19
One-third time	15	12½
One-quarter time	16	9½

tuition and all fees except the Hospital-Medical-Surgical Insurance fee. The above table lists the provisions of various assistantships. Applications may be made directly to the relevant University department.

Graduate students who hold academic appointments for the winter and spring quarters of one academic year, either as employees or fellows, and for whom tuition and/or fees have been provided through waiver or through cash payment by an outside agency, are entitled to a waiver of the same kinds of tuition and fees for the summer quarter immediately following, provided they do not hold appointments during the summer quarter.

\*The District Director of Internal Revenue has ruled that under certain conditions income tax need not be withheld from remuneration paid to research assistants engaged in thesis research.

## Tuition-and-Fee Waivers

A graduate tuition-and-fee waiver provides exemption from tuition and all incidental fees (except the Hospital-Medical-Surgical Insurance fee) for the academic year. To hold these awards students must be in residence and must register for at least 12 hours per quarter during the academic year. They may, however, accept part-time or incidental employment not to exceed 20 hours a week either within or without the University.

Veterans who are admissible to a graduate program and who meet certain residence requirements may be eligible for exemption from tuition and certain fees under the State statute covering Military Scholarships. Further information may be obtained from the Office of Financial Aid, Room, 850, University Hall.

## How to Apply

Application materials and instructions may be obtained from the Graduate College or from any graduate department. Only one application form is needed to apply for any of the types of financial aid listed.

To be considered for a University Fellowship beginning in September, the application should be filed with the major department no later than the preceding February 15. Applications for tuition-and-fee waivers and assistantships are accepted by the departments after that date, but applicants for such appointments are strongly urged to submit their applications as early as possible since many departments offer their assistantships at the same time they consider applications for fellowships.

## Announcement of Awards

Most of the fellowship awards are announced by the Graduate College on or about April 1. Recipients are expected to accept or decline by April 15. The University of Illinois adheres to the following resolution adopted by the members of the Association of American Universities and a number of other graduate schools in North America.

In every case in which a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or a prospective graduate student, the student, if he indicates his acceptance before April 15, will still have complete freedom to reconsider his acceptance and to accept another fellowship, or graduate assistantship. He has committed himself, however, not to resign an appointment after this date unless he is formally released from it.

## Loans

*Long-Term Loan Funds* may be available to those students who have a demonstrated financial need. Loans approved by the Director of Financial Aid are subject to the availability of funds, and no commitment is made until all financial information has been reported. The signature of a qualified endorser or satisfactory collateral is required for all long-term loans. Exceptions to this requirement may be made by the terms of the loan fund or may be waived in meritorious cases by the Director of Financial Aid.

Students must be in good standing before an application is accepted for processing. If loans are valid for a three-quarter period, the student must remain in good standing to receive a second advance. Any exceptions to this rule must be requested from the Office of Financial Aid. The Office of Financial Aid maintains a list of loan sources, such as private foundations, church-related sources, and bank sources in addition to those below. This information will be provided upon request.

*University Loans.* A student may borrow from the University Loan Fund an amount not to exceed \$1,000 per year or a total of \$2,500. He must begin to repay his loan, at an interest rate of 3 percent annually, within four months after leaving the University, and he has up to four years in which to make complete repayment.

*National Defense Education Act Loans.* A graduate student may borrow money from funds provided to the University under Title II of the National Defense Education Act. The limit is \$2,500 per year, to a total of \$10,000. He must begin to repay his loan, at 3 percent interest annually, nine months after he has ceased to pursue a full-time course of study at the University, and the entire loan must be repaid within ten years after repayment begins.

It should be noted, however, that up to 50 percent of a National Defense Education Act loan will be cancelled if the borrower serves as a full-time teacher in a public or nonprofit private school in the United States. This applies to elementary or secondary schools, as well as to institutions of higher education. Such cancellation will be at the rate of 10 percent of the loan for each academic year of such service. Teaching in designated "hardship" areas carries loan cancellation up to 100 percent.

Cosigners are not required for NDEA loan funds.

*United Student Aid Fund Loans.* A graduate student may borrow up to \$1500 per year. The maximum amount that a student may borrow under all guaranteed loan programs is \$7,500. The amount of the loan will be determined on an individual basis. No notes under this plan may bear more than 7 percent simple interest. Repayments begin the first day of the tenth month after the student ceases to be a full-time student. Repayment is scheduled over a period of not less than 5 years nor more than 10 years. Monthly installments may not be less than \$30.

*Illinois State Guaranteed Loans.* The Illinois General Assembly has authorized an Illinois loan program to guarantee student loans made by commercial lenders to legal residents of the State of Illinois. An eligible student may borrow from a minimum of \$300 to a maximum of \$1,500. It is expected that a student will borrow only once during the academic year. Repayment does not begin until the student either graduates or ceases full-time study. A loan will not be granted in an amount which exceeds the established educational expenses at the eligible college selected by the student, minus other scholarship or loan assistance. Applications may be secured from the Office of Financial Aid, 812 University Hall.

*Short-Term Emergency Loans.* Students may request short-term emergency loans from \$5 to \$100. The loan must be paid within forty-five days or by the end of the quarter, whichever date is earlier. Request forms may be obtained from the offices of the Dean of Men or Dean of Women, Room 809, University Hall.

## Employment

The Student Employment Office, 810 University Hall, welcomes the opportunity to counsel students about employment. The office also offers students a library of job-reference materials, job listings, interviews, and referrals for employment to University departments and to agencies and business firms in the Chicago area. Securing a position through proper application and retaining that position through good work is, of course, the responsibility of the individual.



# Campus Facilities and Student Services

## Library

The University Library provides the books, periodicals, and related materials required to meet the instructional needs of the student. Library collections necessary for keeping scholars informed in their respective fields are currently in a state of rapid growth.

*Government Documents.* The Library has been a depository for United States government documents since 1957. The map collection contains topographical, army, and state highway maps. Numerous materials are available in microfilm or microprint.

*The Department of Special Collections* administers the Library's collection of maps and rare books and a growing collection of manuscripts. Included are materials in the fields of social welfare, politics, and labor, as well as those relating to various Chicago religious and ethnic groups. Among these materials are the records of the Chicago Urban League, the Juvenile Protective Association, the Illinois Humane Society, the Chicago League of Women Voters, and the Metropolitan Housing and Planning Council of Chicago. The Jane Addams Memorial Collection, located in the restored Hull Mansion on the Chicago Circle campus, contains books, manuscripts, and memorabilia dealing with Miss Addams' life and work and with the social welfare movement. All such materials are available to faculty and graduate students for research.

*The Urban Historical Collections* contain several thousand items related to urban affairs, Negro history, social settlement work, Hull House, Chicago politics, and ethnic history, all of which are available for research not only to established scholars but to graduate students in urban-related disciplines.

A detailed outline of the general collections and suggestions for effective use of the library will be found in the Library Handbook, copies of which are available at all Library service desks.



## The Computer Center

Recognizing that large-scale electronic computers are now in widespread use as a research tool in nearly all scholarly disciplines, the University has established a Computer Center that is charged with administering a facility to meet the educational and research needs of the University.

The present Computer Center equipment includes an IBM 360 Model 651 computer with 524,288 bytes of .75 microsecond core storage and 1,050,176 bytes of 8 microsecond core storage. In addition to the main facility, there are a number of medium-speed remote job entry stations, which allow jobs to be submitted to the main computer facility from remote locations. An extensive conversational time-sharing system is also in operation with a number of typewriter consoles located throughout the campus. Also in operation is an IBM 1800 process control computer with 32,768 words of 2 microsecond core storage.

The staff members of the Computer Center teach courses in programming and numerical analysis in cooperation with the Department of Mathematics and the College of Engineering. The staff also assists other departments in utilizing the equipment for both teaching and research throughout the campus.

## Housing Office

The Housing Office offers a wide range of services to graduate students. Daily and weekly housing can be arranged while newly arrived graduate students are searching for permanent quarters. Special rates are available at motels convenient to the campus when reservations are made through this office. Daily rates vary from \$5 to \$15 for a single room, and from \$16 to \$20 for a double room. Transportation for students wishing to visit available housing will be arranged by appointment.

A multiple listing of privately owned housing including furnished and unfurnished apartments, houses for rent or sale, and rooms for rent is maintained in this office. Persons listing housing have signed a pledge not to discriminate on the basis of race, religion, or national origin.

Every effort is made to assist those seeking roommates; the files contain listings by individuals who wish to share accommodations. The Housing Office also cooperates with off-campus organizations specializing in roommate location.

Additional information is available from:

Office of Auxiliary Services

Housing Office

Box 4348, Chicago, Illinois 60680

Telephone: (312) 663-5059

## Laboratory Facilities

At present the Departments of Biological Sciences, Chemistry, Geological Sciences, and Physics and the engineering sciences occupy research facilities in the Science and Engineering Laboratories, the twin buildings at the south end of the main campus; the first four departments occupy, in addition, the new Science and Engineering South building located between Taylor Street and Roosevelt Road, south of the present laboratories. These buildings afford considerable space for housing specialized equipment, the details of which are available from the department concerned.

*The Phonetic-Linguistic Research Laboratory* contains recording and specialized equipment patterned after a similar installation at the University of Hamburg.

*The Behavioral Science Center* contains research laboratories for demography, sociology, and psychology.

## Facilities Within the City

The University of Illinois Medical Center departments cooperate with the Chicago Circle Departments of Biological Sciences, Chemistry, Psychology, and Sociology in encouraging joint graduate study, seminars, and the use of the Medical Library.

The Newberry Library (social sciences and humanities), the Crerar Library (science and technology), the Art Institute, the Field Museum of Natural History, the Museum of Negro History, the Library of International Relations, the Center for Research Libraries, the Chicago Historical Society, and the Chicago Municipal Reference Library are important nearby institutions for research.

## Student Affairs

The Office of Student Affairs provides a wide variety of activities and services for students and student life at Chicago Circle. Some of the services immediately relevant to many graduate students are described below.

### The Dean of Men and the Dean of Women

The offices of these deans administer special emergency loan funds and serve as advisers for assistance with personal and budget problems. They also provide assistance in finding housing in Chicago or in Urbana if a student plans to transfer.

## The Student Counseling Service

By providing personal counseling, specialized group services, and psychological testing, the Student Counseling Service aims to foster the educational, vocational, and personal development of the student so that he may attain maximum benefits from his educational experiences. It is the privilege of the student to make use of the following services whenever the need arises.

*Educational, Vocational, and Personal Counseling* are available to any student who may be uncertain about his choice of college or major or who needs help in choosing an occupation or who is concerned with personal problems.

*Group Services* are provided for the student who wishes to improve his reading comprehension and speed, who wants to establish better study methods, who needs help in planning a career, or who wishes to develop his interpersonal skills.

*Individual and Group Tests* are offered to registered students in support of educational, vocational, and personal counseling. In addition, the student interested in taking various national examinations for admission to graduate and professional colleges may wish to consult with the Student Counseling Service.

*The Speech and Hearing Clinic*, under the auspices of the Student Counseling Service, provides, free of charge, facilities for hearing testing, diagnostic speech and voice evaluations, and correction of speech problems. Students who wish assistance in correcting speech difficulties, including those arising from foreign accents, hearing impairments, and voice or articulation problems, should avail themselves of the services of the clinic, which is located in 202 Grant Hall.

## The University Health Service

The University provides clinic services for both preventive medicine and treatment. The cost of most medical expenses that cannot be assumed by the Health Service is covered by the student Hospital-Medical-Surgical Insurance, supervised by the Insurance Division of the Business Office, for which the student pays a quarterly fee.

Beds for the temporary day care of ill students are provided; however, the University does not provide hospital care for its students, the large majority of whom are from families living in the Chicago area; hence, cases requiring bed care are referred to the student's family doctor and to hospitals of the community.

## The Office of Organizations and Activities

More than 200 registered student organizations at Chicago Circle are assisted by this office in the conduct of their constitutional, financial, and social functions. Out-of-class activities and organizations are encouraged as a part of the broad education of the student, through which he may prepare himself for informed membership, including leadership, in community affairs.

The range of student organizations includes educational, preprofessional, political, religious, social-issue, arts, literary, and recreational groupings. Additional organizations will be formed with further development of the campus.

## Foreign Student Affairs

Foreign students are assisted in evaluating their abilities, planning their programs, and interpreting regulations applicable to them. This service includes assistance on problems of extension of stay, employment, border crossing, and details of maintaining legal status, housing, and understanding of the American way of life.

## Placement Services

Graduate students as well as seniors who will begin their careers immediately after they are graduated are encouraged to register at the Placement Office for counseling, for aid in getting in touch with employers, and for planning and scheduling interviews with those representatives of business firms, government agencies, and nonprofit organizations who visit the Chicago Circle campus in the fall and the spring. Students should register early in the fall of the year to avoid missing important interviews with representatives of firms from all over the United States.

The aims of the Placement Office are: to assist the University graduate in making a wise and responsible choice of a career for his own greatest satisfaction, to eliminate wasteful turnover, and to assist the graduate in achieving the most fruitful long-term investment of his talents for himself, for his employer, and for society.



# The Departments

All department admission and degree requirements are in addition to those of the Graduate College. Students must familiarize themselves with both sets of requirements. Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

## ANTHROPOLOGY

**Professors:** Laura A. Bohannon, Charles A. Reed

**Associate Professors:** Susan T. Freeman, Robert L. Hall, Jack H. Prost

**Assistant Professors:** Elizabeth A. Brandt, Merwyn S. Garbarino, Paul E. Hockings, Gibson McGuire, Stephen L. Schensul, Sylvia J. Vatak

The department offers a program leading to the Master of Arts.

## Admission Requirements

Applicants must have a baccalaureate degree from an accredited college or university and must meet the requirements for admission to the Graduate College. Under ordinary circumstances, they must have a grade-point average of 4.000 (A=5.000) for the last 90 quarter hours of undergraduate study and must rank above the 70th percentile on the Graduate Record Examination verbal and quantitative tests. Three letters of recommendation and a brief statement outlining the student's professional goals must be submitted. Students entering without an adequate background in anthropology will be expected to make up deficiencies before formal admission to candidacy is granted.

## Degree Requirements

A minimum of 48 quarter hours is required for the master's degree. All candidates must complete the course work outlined below, pass a comprehen-



sive examination, and submit a thesis. Students engaged in specialized thesis research that demands a reading knowledge of a foreign language or a working knowledge of statistics will be expected to demonstrate satisfactory comprehension of the relevant language or skill. Foreign students must have adequate facility in the English language.

Students are required to complete a minimum of 36 quarter hours of study before admission to the comprehensive examination for the M.A. in anthropology. The distribution of graduate courses is:

12 quarter hours in Anthropology 400, Theory and Method in Anthropology; 430, Theory and Method in Physical Anthropology; 450, Theory and Method in Prehistory.

16 quarter hours in advanced courses in anthropology or related fields, e.g., sociology, political science, psychology, or history.

A minimum of one seminar in the anthropological field of specialization.

No more than 16 hours in Anthropology 499, Thesis Research.

After three quarters of residence a candidate ordinarily is expected to pass a comprehensive examination covering the following fields of anthropology: theory and method in social and cultural anthropology; physical anthropology; archaeology; and ethnology of one culture area, such as North America, Mesoamerica, Africa, or Mediterranean Europe.

## Courses for Graduate and Advanced Undergraduate Students

310. **Peasant Societies.** 4 hours. Research and reading in the comparative study of peasant societies in diverse regions of the world; special emphasis, during lecture and discussion, on a critical review of the anthropological literature delineating a peasant stratum of social organization and defining its characteristics. Prerequisites: 8 hours of social anthropology or 8 hours of sociology and consent of the instructor.
311. **Cultural Problems in Urbanization.** 4 hours. The processes of urbanization and of cultural and societal adjustments to urban life; case studies illustrate the variety of adjustments to urban life. Prerequisite: Anth. 213.
314. **Kinship, Family, and Household.** 4 hours. Comparative study of the institutions of marriage, family, and household; the extension of kinship norms and values to other aspects of culture and society. Prerequisite: Anth. 213.
315. **Comparative Religious Movements.** 4 hours. Analysis of religious behavior; special reference to the emergence of messianic cults in Africa, Melanesia, and among North American Indians and New World Negroes. Prerequisites: 8 hours of social anthropology or 8 hours of sociology and consent of the instructor.
316. **Economic Life of Primitive Peoples.** 4 hours. Patterns of production, distribution, and consumption in non-Western cultures. Cultural variation in attitudes toward labor, concepts of property, and prestige and wealth. Prerequisite: 8 hours of social anthropology; for nonmajors, consent of the instructor.

317. **The Cross-Cultural Study of Social Control.** 4 hours. Cultural-jural structures in non-Western societies; modes of dispute settlement, nature and range of sanctions, and processes of social control. Prerequisite: Anth. 213 or 327.
321. **Cultural Evolution.** 4 hours. Critical review of theories; examination of ethnographic materials and data on cultural change and cultural contact for the purpose of examining the mechanisms of change. Prerequisite: Anth. 200.
322. **Comparative Methods in Social Anthropology.** 4 hours. Introduction to the several kinds of comparative method, including field work, small-sample and large-sample studies. Prerequisites: Anth. 213 and Soc. 185 or the equivalents.
327. **Primitive Political Systems.** 4 hours. Examination of data and theory pertinent to non-Western political systems; a cross-cultural study of political behavior. Prerequisite: Anth. 213.
330. **Primate Evolution.** 4 hours. Same as Biological Sciences 330. Paleontology and systematics of fossil primates as illuminated by the anatomy, ecology, and behavior of the living populations. Prerequisite: Anth. 231 or BioS. 282 or 318.
331. **Human Evolution.** 4 hours. Same as Biological Sciences 31. The phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or 231, or BioS. 282 or 318.
350. **Problems in Prehistoric Archaeology.** 4 to 12 hours. May be repeated for credit up to a total of 12 hours. Archaeological field techniques and principles of the study of prehistory. Case studies from selected areas of the Old and New Worlds. Prerequisites: 12 hours of archaeology and consent of the instructor.
351. **Prehistory of the Near East.** 4 hours. Consideration of southwestern Asia and northeastern Africa as the core area in which the first civilizations emerged. Emphasis on the late Quaternary to about 5000 B.C.; the interrelationships between changing environment, human ecology, and cultural evolution. Prerequisite: Anth. 251 or consent of the instructor for qualified students from other departments.
352. **Early Civilization of the Old World.** 4 hours. Early civilization and incipient urbanization in Eurasia and Africa, with focus on the development of urban centers and archaic states; attention to preconditioning factors in the post-Pleistocene, Mesolithic, and Neolithic Ages. Prerequisite: Anth. 251 or 351.
355. **Field Problems in Archaeology.** 6 to 12 hours. Application of advanced techniques to the solution of special problems of archaeological field investigations; laboratory analysis under field conditions at an off-campus location. Prerequisites: Anth. 253 or 255 or concurrent registration in Anth. 255 and consent of the instructor.
361. **Problems in Mesoamerican Ethnology.** 4 hours. Intensive investigation of selected problems from the Mesoamerican area; special emphasis on religion, economics,

and social organization. Prerequisites: Anth. 261 and a reading knowledge of Spanish.

362. **Problems in African Ethnology. 4 hours.** Survey of the indigenous cultures of Africa; native cultures as reconstructed coterminous with their early historical contacts with the Western world; some additional data on present-day African cultures. Prerequisite: Anth. 263.
363. **Urban Cultures of Africa. 4 hours.** The indigenous urban centers of sub-Saharan Africa and the multicultural and multiracial metropolitan areas of colonial and contemporary Africa; special reference to the processes of segregation and detribalization. Prerequisite: Anth. 263 or 362.
364. **Problems in North American Ethnology. 4 hours.** Intensive reading and research focusing on special problems of religious, economic, and social systems of New World native peoples. Prerequisite: Anth. 264.
365. **Problems in Pacific Ethnology. 4 hours.** Ethnological survey of the indigenous peoples of Micronesia, Polynesia, Melanesia, and Australia; special emphasis on the social, economic, and religious life of representative groups. Prerequisite: 8 hours of social anthropology.
368. **Problems in European Ethnology. 4 hours.** Advanced reading and research in the ethnology of rural Europe; study in depth of selected case materials. Emphasis on community structure, kinship, religious and economic systems, and methods of social control; research techniques and the nature of source materials. Prerequisite: Anth. 213.
380. **Problems in Linguistic Analysis. 4 hours.** Same as Linguistics 380. Examination of the methods and techniques used in linguistics, with reference to actual language data; emphasis on anthropological applications. Prerequisite: Anth. 280 or Ling. 315.
395. **Seminar in Anthropology. 2 to 4 hours.** May be repeated for a total of 8 hours. Reading, study, and discussion of selected problems. For graduate students and majors in anthropology; open, with the approval of the department, to seniors minoring in anthropology. Prerequisite: Consent of the instructor.
399. **Independent Study. 2 to 12 hours.** May be repeated for credit. Independent study under the supervision of a staff member. Prerequisite: Approval of the department.

## Courses for Graduate Students

400. **Theory and Method in Social Anthropology. 4 hours.** Survey of contemporary and historical approaches to problems of field and library research. Prerequisite: Consent of the instructor.

410. **Advanced Study of Kinship. 4 hours.** Investigation of patrilineal, matrilineal, and bilateral kinship systems; the correlations between kinship systems and social structure; the relationships of ecological factors and kinship organization to rural and urban communities. Reading and research on special problems of kinship, marriage, residence, inheritance, authority patterns, and change. Prerequisite: Consent of the instructor.
414. **Psychological Anthropology. 4 hours.** Advanced work on the relationships between the psyche, culture, and society; special reference to cross-cultural investigations. Problems of methodology. Prerequisite: Consent of the instructor.
427. **Political Anthropology. 4 hours.** Problems in analysis and description of non-Western political systems and their articulation into modern state systems. The relationship of the levels of political complexity to theories of political behavior. Prerequisite: Consent of the instructor.
430. **Theory and Method in Physical Anthropology. 4 hours.** Genetics and selection as correlated with the adaptive radiation of the primates, particularly the biological, environmental, and cultural factors associated with the evolution of man. Prerequisite: Consent of the instructor.
450. **Theory and Method in Prehistory. 4 hours.** Aims and methods of archaeological reconstruction; particular attention to paleoecology, the interpretation of archaeological findings in social terms, and the application of scientific knowledge from other fields to archaeological problems. Prerequisite: Consent of the instructor.
480. **Seminar in Sociolinguistics. 4 hours.** Same as Linguistics 480. Past and current approaches to sociolinguistics; variations of linguistic structure with social structure among different linguistic groups. Prerequisite: Anth. 380.
490. **Seminar on Comparative Social Institutions in Western and Non-Western Societies. 4 hours.** May be repeated twice for credit. Each seminar will select for intensive study a single problem relating to such social institutions as social stratification, political organization, warfare, or religion. Prerequisite: Consent of the instructor.
491. **Seminar in Ethnology. 4 hours.** May be repeated twice for credit. Advanced seminar in the analysis of ethnological data, focusing on the interpretation of field data from selected geographic regions and on correlated theoretical problems. Prerequisite: Anth. 400.
492. **Readings in the Ethnography of Ethiopia. 4 hours.** May be repeated twice for credit. For advanced students in social anthropology. Guided study in the social anthropology of Ethiopian tribal societies; special consideration of the central Ethiopians and western Cushites, the pastoral complex, tribes of the Rift Valley lakes. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.



495. **Developmental Sources of Anthropological Theory.** 4 hours. Seminar on the sources relevant to the current and historical development of anthropological theory primarily as they derive from interaction among the subfields of anthropology but also as these influence, and are influenced by, other disciplines. Prerequisites: Anth. 400; and 414, 430, or 450.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Consent of the student's adviser.

## BIOLOGICAL SCIENCES

**Professors:** Elmer B. Hadley, Head of the Department; Donald A. Eggert, Sidney F. Glassman, Bernard Greenberg, Helene N. Guttman, Marion T. Hall, Robert F. Inger, Albert S. Rouffa, Stanley K. Shapiro, Rolf Singer (Visiting), Eliot B. Spiess

**Associate Professors:** Louise Anderson, David Bardack, Howard E. Buhse, Jr., M.A.Q. Khan, David B. Mertz, Darrel L. Murray, John A. Nicolette, Jack H. Prost, Charles N. Spirakis, Thomas N. Taylor, Robert B. Willey

**Assistant Professors:** James A. Bond, Shepley S.C. Chen, Michael R. Cummings, Merrill Gassman, Manuel Goldman, David G. Penney, Thomas W. Seale, Spencer A. Tomb, Ruth L. Willey

The Department of Biological Sciences offers work leading to the Master of Science in Biology.

## Admission Requirements

Applicants must have a Bachelor of Arts or a Bachelor of Science degree from an accredited college or university and a grade-point average of at least 3.750 (A=5.000) for the last 90 quarter hours of undergraduate study. A student whose average is between 3.500 and 3.750 may petition for consideration.

Applicants must have 30 quarter hours in biological sciences, excluding 100-level (introductory) courses, that indicate a broad, well-balanced selection of courses in biology.

*Collateral Requirements:* Chemistry (including two quarters of organic chemistry, one year each of physics and mathematics, preferably including introductory calculus. Deficiencies determined by the Graduate Committee of the Department of Biological Sciences and the student's adviser must be made up early in the student's residence.



Applicants who have majored in fields other than biological sciences are encouraged to contact the department prior to making formal application for admission.

All students who apply for admission must submit the following:

A completed application form.

Complete transcripts of undergraduate (and any graduate) course work.

Three letters of recommendation, preferably from professors who are familiar with the student's recent work.

A statement of about 250 words presenting the applicant's reasons for desiring to take graduate work in biological sciences and the relationship of this work to his professional and other goals.

Graduate Record Examination for both the Aptitude Test and the Advanced Test in his major field.

## Courses for Graduate and Advanced Undergraduate Students

300. **Seminar.** 0 to 1 hour. Faculty and visiting biologists discuss results of their research programs before staff and students at weekly meetings. Attendance of majors at all meetings is strongly encouraged. Prerequisite: Biological sciences major.
303. **Quantitative Biology I.** 5 hours. Quantitative ideas and mathematical models in the development of biological theory and as a basis for biological experimentation. Lecture and laboratory. Prerequisites: Math. 131 and BioS. 240 or 315.
304. **Cytology Laboratory.** 3 hours. Advanced cytology; emphasis on instrumental methods. Prerequisites: BioS. 261 and concurrent registration in BioS. 309.
305. **Quantitative Biology II.** 5 hours. Formal aspects of biological experimentation, including the basic aspects of experimental design; interpretation of biological data. Lecture and laboratory. Prerequisite: BioS. 303.
307. **Biological Methods for Teachers.** 3 hours. Investigation of methodological subject matter, conducted primarily as a practicum; emphasis on the development of competencies. Prerequisite: 40 hours of biological sciences.
309. **Cytology.** 3 hours. Structure and function of cells as revealed through historical development and modern research techniques. Lecture. Prerequisite: Two years of biological sciences.
313. **Developmental Biology.** 4 hours. Principles governing growth and differentiation at molecular, fine structural, cellular, and organismic levels. Lecture and laboratory. Prerequisite: One year of biological sciences.
315. **Principles of Ecology.** 3 hours. Composition and distribution of biotic communities, plant and animal; emphasis on the interplay of physical and biological factors of the environment. Prerequisites: One year of biological sciences and concurrent registration in BioS. 324 or 380.

## BIOLOGICAL SCIENCES

### Degree Requirements

*Hours:* 48 quarter hours of approved graduate work of which at least 18 must be in 400-level courses.

*Thesis:* Candidates must submit an acceptable thesis and pass a comprehensive final examination. A maximum of 16 quarter hours in Biological Sciences 499, Thesis Research, may be credited. Candidates whose interests lie in secondary education may be exempted from the thesis requirement at the option of the department. In lieu of the thesis, they will substitute satisfactory performance on the oral comprehensive examination and 4 to 12 quarter hours of Biological Sciences 493, Problems in Modern Biology.

*Comprehensive Examination:* Oral; the candidate must demonstrate competence in two of the three areas of specialization and familiarity (satisfiable by A or B grades in approved courses) with the third. Candidates electing a thesis must take an oral examination, administered by a committee including members of his advisory committee, which tests the candidate on his general biological knowledge and on the purpose and content of his thesis.

Degree candidates are urged to achieve competence in at least one modern foreign language and to register for courses in calculus, statistics, and biochemistry.



316. **Invertebrate Paleontology.** 4 hours. Same as Geological Sciences 316. Phylogeny, morphology, and ecology of the fossil invertebrates. Prerequisites: BioS. 218 and consent of the instructor.
318. **Vertebrate Paleontology.** 4 hours. Same as Geological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisites: BioS. 281 and consent of the instructor.
319. **Paleobotany.** 5 hours. Same as Geological Sciences 319. Structure, phylogeny, and stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.
320. **Field Botany.** 5 hours. Flora of the Chicago region. Lecture, laboratory, field trips. Prerequisite: One year of biological sciences.
321. **Plant Geography of North America.** 4 hours. Ecological and systematic treatment of vegetation regions and principal subdivisions; emphasis on environmental factors and floras. Prerequisite: BioS. 220 or 315.
324. **Plant Ecology Laboratory.** 2 hours. Special attention to vegetation and environment of the Chicago region. Laboratory and field trips. Prerequisite: Concurrent registration in BioS. 315.
325. **Plant Anatomy.** 4 hours. Examination of the internal structure of vascular plants; emphasis on structure and function. Lecture and laboratory. Prerequisite: One year of college biology or the equivalent.
326. **Plant Physiology I.** 3 hours. Photobiology of photosynthesis, photosynthetic carbon metabolism, formation of the photochemical apparatus, and respiration. Prerequisite: BioS. 261 or the equivalent.
327. **Plant Physiology II.** 3 hours. Water relations, translocation of solutes, growth, flowering, and phytohormones. Prerequisite: BioS. 261 or the equivalent.
328. **Plant Physiology Laboratory I.** 2 hours. Laboratory techniques. Prerequisites: BioS. 261 or the equivalent and concurrent registration in BioS. 326.
329. **Plant Physiology Laboratory II.** 2 hours. Laboratory techniques. Prerequisites: BioS. 261 or the equivalent and concurrent registration in BioS. 327.
330. **Primate Evolution.** 4 hours. Same as Anthropology 330. Paleontology and systematics of fossil primates as illuminated by the anatomy, ecology, and behavior of the living populations. Prerequisite: Anth. 231 or BioS. 282 or 318.
331. **Human Evolution.** 4 hours. Same as Anthropology 331. Phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or 231, or BioS. 282 or 318.

332. **Morphogenesis in Higher Plants.** 3 hours. Morphogenesis, growth, and differentiation of vascular plants and bryophytes. Emphasis on experimental approaches to plant development at the molecular, cellular, and organismic levels. Lecture. Prerequisites: Chem. 234 and BioS. 313 or 33.
333. **Morphology of Vascular Plants.** 4 hours. Structure, reproduction, and evolutionary history of representative vascular plants, including psilopsids, lycopsids, sphenopsids, ferns, gymnosperms, and angiosperms. Lecture and laboratory. Prerequisite: One year of biological sciences.
342. **Cytogenetics.** 4 hours. Chromosomal phenomena involved in the mechanics of genetics, structure of genetic material, and the role chromosomal variation plays in the evolution of races and species. Lecture and laboratory. Prerequisite: BioS. 240.
343. **Population Genetics.** 3 hours. Genetic dynamics for animal, plant, and human populations: mating systems, selection, sampling, and mutation. Lecture and recitation. Prerequisites: BioS. 240, Math. 130, and credit or concurrent registration in statistics.
344. **Experimental Population Genetics.** 3 hours. Discussion of experimental and field empirical studies estimating genetic parameters, influence of selection, and other evolutionary forces on genotypes in populations. Lecture, laboratory, and discussion. Prerequisite: BioS. 343.
345. **Systematics and Evolution.** 3 hours. Consideration of principles and interrelationships; basic analysis of evolutionary mechanisms; rationale for classification systems; nature of taxonomic characters. Lecture and discussion. Prerequisites: One year of biological sciences and BioS. 240.
347. **Physiological Genetics.** 3 hours. Consideration of heredity at the biochemical level; particular reference to mutation, the transcription and translation of genetic information, and genetic regulatory mechanisms. Lecture. Prerequisites: BioS. 240 and Chem. 350.
349. **Evolutionary Theory.** 3 hours. Analysis of evolutionary mechanisms in plants and animals; variation and differentiation in populations and species; origins of superspecific taxa. Prerequisites: BioS. 315 and 345.
350. **Advanced Microbiology.** 5 hours. Modern contributions to the cellular anatomy, physiology, and genetics of microorganisms. Lecture and laboratory. Prerequisites: BioS. 250 or 261, and credit or registration in biochemistry. Calculus is strongly recommended.
351. **Principles of Cell and Tissue Culture.** 5 hours. Methods for primary isolation of plant and animal tissue and subsequent cultivation. Uses of cells in cultures as experimental tools. Prerequisites: BioS. 250 and 261.
353. **Chemical Biogenesis.** 4 hours. Same as Chemistry 353. Biosynthesis of important biological compounds. Lecture and discussion. Prerequisite: Chem. 134 or 234.



356. **Mycology.** 4 hours. Analysis of the morphology, physiology, and genetics of fungi as related to the taxonomy and phylogeny of fungi. Lecture and laboratory. Prerequisite: One year of biological sciences.
359. **Neuroanatomy.** 5 hours. Introduction to the neurological organization of the mammalian central nervous system. Prerequisites: BioS. 280 and consent of the instructor.
361. **Macromolecules of Biological Importance.** 5 hours. Nucleic acids and proteins; emphasis on their roles in the replication of genetic material. Lecture and laboratory. Prerequisites: A course in organic chemistry and consent of the instructor.
363. **Animal Physiology I.** 5 hours. Same as Information Engineering 383. The role of the digestive, circulatory, respiratory, and osmoexcretory systems in the maintenance of organismic homeostasis. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.
364. **Animal Physiology II.** 5 hours. Same as Information Engineering 384. The role of the muscular, sensory, nervous, and endocrine systems in the maintenance of organismic integration. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.
366. **Microbial Physiology I.** 5 hours. Organization of physiological processes in various groups of microorganisms: comparative biochemistry of energy-yielding mechanisms; biosynthesis of macromolecules; ecological implications of microbial metabolism. Lecture, discussion, laboratory. Prerequisite: BioS. 250 or the equivalent.
370. **Biochemistry I.** 4 hours. Same as Chemistry 350. Chemistry of biological systems, including proteins and enzymes. Prerequisites: Chem. 119 or 121 and credit or registration in Chem. 235.
371. **Biochemistry II.** 4 hours. Same as Chemistry 351. Continues Biological Sciences 370. Carbohydrate and lipid metabolism. Electron transport. Prerequisite: BioS. 370.
372. **Biochemistry III.** 4 hours. Same as Chemistry 352. Continues Biological Sciences 371. Metabolism of amino acids, nucleic acids, proteins, and the biosynthesis of biological macromolecules. Prerequisite: BioS. 371.
375. **Comparative Vertebrate Physiology I.** 4 hours. Comparison of selected physiological adaptations of various vertebrate groups to the factors of the environment at the whole animal and organ system levels. Lecture and laboratory. Prerequisite: BioS. 363 or 384.
377. **Endocrinology.** 5 hours. Animal hormones in the control of integration, homeostasis, growth, and development. Lecture and laboratory. Prerequisite: BioS. 364.

380. **Animal Ecology Laboratory.** 2 hours. Population and community assemblages of the Chicago region. Laboratory and field trips. Prerequisite: Concurrent registration in BioS. 315.
382. **Environmental Conservation.** 3 hours. Applied ecology of the use of renewable natural resources; special emphasis on biotic problems of land, water, and air management; pollution, population increase, multiple-use concept, and land ethics. Lecture and field trips. Prerequisites: BioS. 315, and 324 or 380.
384. **Invertebrate Zoology I.** 5 hours. Comparative study of structure, development, behavior, classification, and evolution of the lower invertebrate groups. Lecture and laboratory. Prerequisite: One year of biological sciences.
385. **Invertebrate Zoology II.** 5 hours. Comparative study of structure, development, classification, and evolution of the higher invertebrate groups exclusive of arthropods. Lecture and laboratory. Prerequisite: BioS. 384.
388. **General Entomology.** 5 hours. Introduction to the morphology, physiology, classification, behavior, and evolution of insects. Lecture and laboratory. Prerequisite: 12 hours of biological sciences.
389. **Principles of Protozoology.** 5 hours. Introduction to the comparative morphology, physiology, and systematics of the protozoa, including discussion of advances in major areas of current research. Lecture and laboratory. Prerequisite: One year of biological sciences.
393. **Functional Animal Morphology.** 4 hours. Functional analysis of selected invertebrate and vertebrate organ systems applied to problems of comparative structure, adaptation, and phylogeny. Lecture and laboratory. Prerequisite: Consent of the instructor.
395. **Zoogeography.** 3 hours. Examination of present and past distribution of animals; emphasis on physiographic and ecologic factors which affect the development of faunal regions. Experimental methods to elucidate mechanisms of origin and diversification of island and continental faunas.
397. **Biology of Lower Vertebrates.** 4 hours. Experimental and descriptive studies on fishes, amphibians, and reptiles; emphasis on ecology, speciation, and adaptive radiation. Lecture, laboratory, and field trips. Prerequisite: Any one of BioS. 218, 240, 280 or 281.

## Courses for Graduate Students

401. **Foundations of Biological Thought.** 4 hours. Presentation and analysis of some of the fundamental concepts of the mainstreams of biological thought.
402. **Patterns of Biological Enquiry.** 4 hours. Contemporary and developing ideas in biology, utilizing blocks of integrated research papers to analyze the functioning of selected ideas as they influence the design, execution, and interpretation of research problems. Prerequisite: BioS. 401.

403. **Enquiry Processes in the Classroom.** 4 hours. The insights derived from Biological Sciences 401 and 402 are used in preparing inquiry-oriented materials for presentation in the classroom. Prerequisite: BioS. 402.
404. **Methods in Cellular Physiology.** 2 to 5 hours. Analytical techniques and instrumentation used in microbiology, cell biology, and physiology. Practical and theoretical problems associated with these techniques are considered. Prerequisites: Cellular biodynamics or equivalent, and biochemistry or concurrent registration in biochemistry.
406. **Biological Ultrastructure.** 5 hours. Discussion, instrumentation, and special topics in fine structure of plant and animal cells and cell products. Prerequisites: BioS. 261, 309, organic chemistry, and consent of the instructor.
408. **Histochemistry.** 5 hours. Analysis of cell and tissue structure by histochemical methods. Prerequisites: BioS. 261, 309, Chem. 234, and consent of the instructor.
411. **Discussions in Paleobiology.** 1 hour. May be repeated for credit. Consideration of selected topics and current research literature in paleobiology. Prerequisite: Consent of the instructor.
413. **Problems in Evolutionary Paleontology.** 4 hours. Same as Geological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change, such as rates of evolution, population structure, and extinction as shown by the vertebrate fossil record. Prerequisites: BioS. 218 and 305. Biological Sciences 345 is recommended.
415. **Principles of Morphogenesis.** 4 hours. Analysis of factors controlling growth and differentiation in unicellular and multicellular organisms. Prerequisites: BioS. 240 and 313.
416. **Evolution of Pteridophytes.** 4 hours. Basic structure and major features of evolution of lycopods, sphenopsids, and ferns. Prerequisite: BioS. 333 or the equivalent, and consent of the instructor.
417. **Evolution of Gymnosperms.** 4 hours. Basic structure and major features of evolution of naked seeded plants. Prerequisites: BioS. 333 or the equivalent, and consent of the instructor.
418. **Angiosperm Morphology.** 4 hours. Basic structure and major features of evolution within the flowering plants. Prerequisites: BioS. 333 or the equivalent, and consent of the instructor.
419. **Topics in the Morphology and Evolution of Plants.** 1 hour. Seminar. Prerequisites: BioS. 333 or the equivalent; 416, 417, or 418, and consent of the instructor.
420. **Advanced Vertebrate Paleontology.** 4 hours. Same as Geological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups: fishes, amphibians and reptiles, and mammals. Prerequisites: BioS. 282 and 318.

422. **Physiological Ecology of Plants.** 4 hours. Physiological investigation of climatic and edaphic differentiation; emphasis on the ecophysiological adaptations of species to their environments. Prerequisites: BioS. 315, 324, or 380, and one quarter of plant physiology.
423. **Discussions in Ecology and Behavior.** 2 hours. May be repeated for credit up to 8 hours. Consideration of selected topics, current literature, and recent advances in ecology and behavior. Prerequisite: Consent of the instructor.
424. **Advanced Paleobotany.** 4 hours. Problems in the structure and phylogeny of representative fossil plant groups. Lecture, laboratory, occasional field trip. Prerequisite: BioS. 319.
426. **Biochemical Systematics.** 4 hours. Analysis of the utilization of comparative biochemical data in determining evolutionary relationships among groups of plants and animals. Prerequisites: BioS. 345 and 353.
427. **Advanced Taxonomy of Flowering Plants.** 4 hours. Emphasis on theories and data for evolution within groups of flowering plants. Prerequisites: BioS. 345 and consent of the instructor.
428. **Intermediary Metabolism in Plants.** 3 hours. Pathways of carbon metabolism, enzymes involved, and control mechanisms. Prerequisite: BioS. 329 or Chem. 351.
429. **Topics in Systematic Botany.** 4 hours. Specialized systematic studies of the larger, more important families of flowering plants. Lecture, laboratory, and field trips. Prerequisite: BioS. 220 or 315 or 345.
430. **Population Ecology.** 3 hours. The ecology of plant and animal populations. Life histories and population growth, competition, predator-prey systems, population movement, and ecological genetics; emphasis on populational modeling. Prerequisites: BioS. 240, 315, 324 or 380, and consent of the instructor.
436. **Photobiology.** 3 hours. Photobiological processes, including vision, photosynthesis, ultraviolet light as a mutagen, bioluminescence, phototropisms, and photomorphogenesis. Basic techniques in photobiological research. Prerequisites: BioS. 328, 329, and consent of the instructor.
437. **Organelle Biogenesis.** 3 hours. May be repeated once for credit. Organization, development, and reproduction of plastids and mitochondria, including growth, differentiation, continuity, genetics, and autonomy; origin and evolutionary significance of these organelles. Prerequisites: BioS. 261, Chem. 351 or the equivalent, and consent of the instructor.
438. **Experimental Plant Systematics.** 4 hours. Evolutionary mechanisms and pathways in higher plants; analysis of genetic chromosomal, morphological, and physiological properties of natural assemblages at and below the species level of divergence. Lecture and laboratory. Prerequisites: BioS. 342 and 349.



440. **Seminar in Genetics.** 2 hours. Discussion of research literature in the field. Student topics assigned. Prerequisites: BioS. 240 and consent of the instructor.
442. **Problems in Population Genetics.** 3 hours. Lecture and discussion of research literature in the field. Prerequisites: BioS. 343 and 344.
445. **Discussion in Systematics and Evolution.** 1 hour. Consideration of current literature and of recent advances in the field of systematic biology. Prerequisite: Consent of the instructor.
446. **Developmental Genetics.** 4 hours. Principles of genome function during gametogenesis and the onset of differentiation; patterns and mechanisms of gene regulation in differentiated cells. Prerequisites: BioS. 240 and 313.
449. **Virology.** 3 hours. Nature of viruses and their morphology, chemical composition, assay, host-parasite interactions, and life cycles. Prerequisite: BioS. 351.
450. **Topics in Microbial Physiology.** 4 hours. Modern contributions to microbiology, including the ultrastructure of the bacterial cell, metabolism and control mechanisms, bacterial genetics and cell-viral systems. Lecture and laboratory. Prerequisite: BioS. 350.
451. **Insect Microbiology.** 5 hours. Host microbe associations and their commensal, pathogenic, and other interactions. Virus, protozoan, and bacterial associations. Prerequisites: BioS. 250 and 388.
452. **Insect Physiology.** 5 hours. Structure, function, and adaptive aspects of the insect exoskeleton and organ systems; growth, differentiation, and reproduction. Prerequisite: BioS. 388.
455. **Topics in Molecular Biology.** 3 hours. May be repeated for credit. Selected topics emphasizing molecular studies involved in such diverse biological areas as virology, genetics, immunology, photobiology, pharmacology, exobiology. Prerequisites: BioS. 240, 250, 261, and consent of the instructor.
456. **Bacterial Photosynthesis.** 3 hours. Structure and function of the photochemical apparatus in the photosynthetic bacteria; photosynthetic carbon, nitrogen, hydrogen, and sulfur metabolism in the bacteria. Prerequisites: BioS. 250, 328, and 329.
468. **Microbial Physiology II.** 4 hours. Biochemistry of growth of microorganisms; formation of various microbial structures; biosynthesis of major cellular constituents; metabolic regulation; kinetics of microbial growth. Lecture, discussion, laboratory. Prerequisite: BioS. 366.
471. **Comparative Vertebrate Physiology II.** 4 hours. Comparison of selected physiological adaptations of various vertebrate groups to the factors of the environment at the tissue and cellular levels. Lecture and laboratory. Prerequisite: BioS. 470.

## 58 BIOLOGICAL SCIENCES, CHEMISTRY

- 472. **Experimental Animal Physiology.** 4 hours. May be repeated once for credit. Selected topics in experimental surgery and pharmacodynamics. Prerequisite: BioS. 363 or 364.
- 473. **Comparative Invertebrate Physiology.** 5 hours. Adaptive mechanisms of invertebrate animals in their major kinds of habitats. Lecture and laboratory. Prerequisite: BioS. 385.
- 474. **Advanced Invertebrate Physiology.** 5 hours. Detailed study of the physiology of respiration and metamorphosis in invertebrates and of their adaptations in toxic environments. Lecture and laboratory. Prerequisite: BioS. 473.
- 486. **Advanced Invertebrate Zoology.** 4 hours. Selected topics in currently advancing areas of descriptive and experimental invertebrate zoology. Emphasis on recent comparative research in such areas as behavior, embryogenesis, circadian rhythms, and ecological adaptations. Lecture and laboratory. Prerequisites: BioS. 385 or 470 and consent of the instructor.
- 489. **Advanced Protozoology.** 4 hours. Consideration of selected topics in modern protozoological research. Prerequisite: BioS. 389.
- 490. **Problems in Vertebrate Morphology.** 4 hours. Feeding and locomotory mechanisms of selected vertebrates. Dissection, experimentation, and seminar presentation of analyzed results. Laboratory and discussion. Prerequisite: BioS. 393 or the equivalent.
- 492. **Seminars in Biology.** 1 to 3 hours. Seminars in selected aspects of biological sciences.
- 493. **Problems in Modern Biology.** 2 to 8 hours. May be repeated for credit. Not to be used for thesis research. Guided study of selected topics with research potential in specific fields of advanced modern biology. Prerequisite: Consent of the instructor.
- 495. **Graduate Seminar.** No credit. Thesis presentation by advanced students; occasional seminar by staff and invited speakers. Required of graduate students every quarter.
- 499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Work in a number of fields offered under the direction of faculty members with appropriate graduate standing.

## CHEMISTRY

**Professors:** William F. Sager, Head of the Department; Bernard J. Babler, Joseph H. Boyer, Thomas H. Brown, Richard L. Carlin, Charles K. Hunt, Chui F. Liu, Clifford N. Matthews, Robert M. Moriarty, Jan Rocek, Robert I. Walter

**Associate Professors:** Ronald J. Baumgarten, Richard P. Burns, Jacques Kagan, J. Victor Mansfield, Samuel Schrage

**Assistant Professors:** Benedict W. Bangerter, Wade A. Freeman, Eric A. Gislason, David Gorenstein, Anatol Gottlieb, Cynthia J. Jameson, Richard Kassner, Rosalind A. Klaas, Florence C. Klee, Leonard Kotin, John J. Steiner, Robert F. Zahrobsky

Work toward the Master of Science and the Doctor of Philosophy is offered in inorganic, organic, and physical chemistry.

## Admission Requirements

Applicants must have fulfilled the course requirements leading to a bachelor's degree with a major in chemistry and must have a 4.000 grade-point average in mathematics and science courses. Students with lower averages may apply and will be considered individually. Applicants who have majored in fields other than chemistry may be admitted to graduate study in chemistry on an individual basis.

## Degree Requirements

### Master of Science

*Hours:* 48 quarter hours, of which 32 must be within the Department of Chemistry. The remaining 16 hours may be selected from the offerings of other departments on the basis of their relevance to a particular area of interest. Course work in other departments will be strongly recommended when it is judged advisable for the student's best professional development. At least 16 quarter hours must be taken at the 400 level, of which 12 must be selected from the course offerings of the Department of Chemistry.

All M.S. candidates are required to participate in undergraduate teaching, which will be assigned in individual cases according to background and interest. A minimum of 16 quarter hours is required.

*Thesis:* Optional; up to 18 quarter hours of thesis research may be credited, subject to the approval of the department.

## Doctor of Philosophy

In addition to satisfying the general requirements of the Graduate College, students must pass a set of departmental cumulative examinations. The only specific courses required of all candidates are Chemistry 404, 405, and 406, which provide a foundation for the areas of specialization. All other formal course work is determined, with the advice of the department, according to its relevance to the student's field of interest.

*Thesis:* Candidates must prepare a thesis based upon original research carried out under the direction of a qualified member of the department and approved by an examination committee.

All candidates must meet the department foreign language requirement.

Prospective candidates may obtain detailed information concerning all requirements by applying to the Department of Chemistry.

## Courses for Graduate and Advanced Undergraduate Students

314. **Inorganic Chemistry.** 4 hours. Lectures and assigned readings on the chemistry of selected elements. Prerequisite: Chem. 340.
315. **Inorganic Chemistry.** 4 hours. Lectures and assigned readings in structural organic chemistry, inorganic reaction mechanisms and techniques, and the nature of the coordinate bond. Prerequisite: Chem. 342 or the equivalent.
316. **Inorganic Chemistry Laboratory.** 2 hours. Synthesis of inorganic compounds illustrating the use of modern preparative techniques. Prerequisite: Credit or registration in Chem. 315.
321. **Chemical and Instrumental Analysis I.** 5 hours. Chemical and instrumental methods of analysis and their application to the quantitative study of chemical reactions. Prerequisites: Chem. 235 and credit or registration in Chem. 343 or the equivalents.
322. **Chemical and Instrumental Analysis II.** 3 hours. Continues Chemistry 321. Prerequisite: Chem. 321.
338. **Systematic Identification of Organic Compounds.** 3 hours. Primarily a laboratory course; chemical, physical, and spectroscopic methods are used to separate, purify, and identify organic compounds. Prerequisite: Chem. 237.
339. **Organic Synthesis.** 2 to 4 hours. Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Chem. 237 or the equivalent.
340. **Physical Chemistry I.** 4 hours. Credit is not given for both the Chemistry 340, 342, 344 sequence and the 380-382 sequence. Introduction to the study of



chemical principles. Prerequisites: Chem. 119 or 121, credit or registration in Math. 133, and one year of college physics.

341. **Physical Chemistry Laboratory I.** 2 hours. Quantitative experimental study of chemical principles. Prerequisite: Concurrent registration in Chem. 340.
342. **Physical Chemistry II.** 4 hours. Continues Chemistry 340. Prerequisite: Chem. 340.
343. **Physical Chemistry Laboratory II.** 3 hours. Continues Chemistry 341. Prerequisites: Chem. 341 and concurrent registration in Chem. 342.
344. **Physical Chemistry III.** 4 hours. Continues Chemistry 342. Prerequisite: Chem. 342.
345. **Physical Chemistry Laboratory III.** 2 hours. Continues Chemistry 343. Prerequisites: Chem. 343 and concurrent registration in Chem. 344.
347. **Introduction to Quantum Chemistry.** 4 hours. Applications of quantum mechanics to problems of chemical interest. Additional assignments are required. Prerequisite: Chem. 344.
348. **Thermodynamics.** 4 hours. Lectures and assigned readings; applications to chemical systems. Prerequisite: Chem. 344.
349. **Statistical Thermodynamics.** 4 hours. Introduction to statistical mechanics and application to equilibrium thermodynamics. Prerequisite: Chem. 344.
350. **Biochemistry I.** 4 hours. Same as Biological Sciences 370. Chemistry of biological systems, including proteins and enzymes. Prerequisites: Chem. 119 or 121 and credit or registration in Chem. 235.
351. **Biochemistry II.** 4 hours. Same as Biological Sciences 371. Continues Chemistry 350. Carbohydrate and lipid metabolism. Electron transport. Prerequisite: Chem. 350.
352. **Biochemistry III.** 4 hours. Same as Biological Sciences 372. Continues Chemistry 351. Metabolism of amino acids, nucleic acids, and proteins; the biosynthesis of biological macromolecules. Prerequisite: Chem. 351.
353. **Chemical Biogenesis.** 4 hours. Same as Biological Sciences 353. Biosynthesis of important biological compounds. Prerequisite: Chem. 134 or 234.
355. **Biochemistry Laboratory I.** 2 hours. Introduction to experimentation with biochemical systems, processes, and compounds of biochemical importance. Prerequisite: Registration in Chem. 350.
357. **Biochemistry Laboratory II.** 2 hours. Continues Chemistry 355. Prerequisites: Chem. 355 and registration in Chem. 351.

361. **Advanced Organic Chemistry I. 4 hours.** A physical-organic approach to organic reactions with particular emphasis on reaction mechanisms and the relationship between reactivity and structure. Lectures and assigned readings. Prerequisites: Chem. 235 and 344.
362. **Advanced Organic Chemistry II. 4 hours.** Continues Chemistry 361. Lectures and assigned readings. Prerequisite: Chem. 361.
380. **Principles of Physical Chemistry I. 3 hours.** Credit is not given for both the Chemistry 380-382 sequence and the 340-342-344 sequence. Chemistry 380 and 382 provide an elementary introduction to physical chemistry; particular emphasis on topics of importance in the biological and health sciences. Prerequisites: Chem. 119 or 121, calculus, and two quarters of physics.
382. **Principles of Physical Chemistry II. 4 hours.** Continues Chemistry 380. Prerequisite: Chem. 380.
383. **Elementary Physical Chemistry Laboratory. 1 hour.** An introductory course. Prerequisite: Chem. 380.
384. **Surface and Macromolecular Chemistry. 4 hours.** Interfacial phenomena, stability of disperse systems, properties of polymer solutions. Prerequisites: Chem. 382 or the equivalent and consent of the instructor.
385. **Surface and Macromolecular Laboratory. 2 hours.** Techniques in surface and macromolecular chemistry. Prerequisites: Credit or registration in Chem. 384 and consent of the instructor.
399. **Independent Study. 3 hours or more.** May be repeated for credit. Supervised study in an area not represented by regularly offered courses. Prerequisite: Written approval of the department.

## Courses for Graduate Students

404. **Quantum Mechanics. 4 hours.** Exact solution of the Schrodinger equation for simple systems; variational principle; approximation methods in complex systems; effects of electric and magnetic fields. Required of all Ph.D. students in chemistry.
405. **Molecular Spectroscopy. 4 hours.** Analysis and interpretation of molecular spectra, including electronic, vibrational, magnetic resonance and Mossbauer spectra. Required of all Ph.D. students in chemistry.
406. **Chemical Applications of Group Theory. 4 hours.** Introduction to the use of group-theoretical methods in the analysis of spectroscopic problems; ligand and crystal field theory; molecular orbital calculations. Required of all Ph.D. students in chemistry. Prerequisite: Chem. 405.
410. **Current Problems in Inorganic Chemistry. 2 hours.** May be repeated for credit. Analysis of fundamental concepts in inorganic chemistry as they appear in a modern research context.

412. **Special Topics in Inorganic Chemistry.** 2 to 4 hours. Lectures on topics not represented in regularly scheduled courses.
413. **Physical Methods of Inorganic Chemistry.** 4 hours. Application of physico-chemical methods to problems in inorganic chemistry.
414. **Advanced Inorganic Laboratory.** 2 to 4 hours. Experimental methods in synthesis and study of inorganic compounds.
415. **Complex Inorganic Compounds.** 4 hours. Stereochemistry, reactions, and theory of bonding of coordination compounds.
423. **Catalysis in Enzymology.** 4 hours. Application of physical organic chemistry to the understanding of enzyme action and the mechanisms of biochemical reactions. Prerequisites: Chem. 351 and 362.
425. **Bioenergetics.** 4 hours. Thermodynamic changes associated with the formation of chemical gradients, the transformation of metabolites, oxidation-reduction reactions and the synthesis of macromolecules, including detailed consideration of mechanisms of oxidative and photophosphorylation. Prerequisites: Chem. 344 and 351.
431. **Literature Seminar in Organic Chemistry.** 1 hour. Students present papers on current research topics; abstracts are prepared and distributed. Discussion is an integral part of the course.
432. **Special Topics in Organic Chemistry.** 4 hours. Discussion of topics of current interest.
433. **Special Topics in Reaction Mechanisms.** 4 hours. Theory and techniques in specialized areas in reaction mechanisms. Prerequisite: Chem. 362 or the equivalent.
434. **Physical Methods in Organic Chemistry.** 4 hours. Application of infrared, ultraviolet-visible, magnetic resonance, electron spin resonance, and mass spectrometry and optical rotatory dispersion in organic chemistry. Prerequisite: Chem. 405.
435. **Advanced Organic Synthesis.** 4 hours. Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Credit or registration in Chem. 434.
436. **Chemistry of Natural Products I.** 4 hours. Discussion of the more important groups of natural products, including their structure determination, synthesis, and biogenetical relationships. Offered alternate years. Prerequisite: Chem. 235.
437. **Survey of Organic Chemistry I.** 4 hours. Topics on synthesis, mechanisms, and stereochemistry at an advanced level.
438. **Survey of Organic Chemistry II.** 4 hours. Continues Chemistry 437. Prerequisite: Chem. 437.

439. **Survey of Organic Chemistry III.** 4 hours. Continues Chemistry 438. Prerequisite: Chem. 438.
440. **Current Problems in Physical Chemistry.** 2 hours. May be repeated for credit. Analysis of fundamental concepts in physical chemistry as they appear in a modern research context.
442. **Special Topics in Physical Chemistry.** 2 to 4 hours. Lectures and reading in areas not normally treated in standard courses. Discussions of topics of current interest.
443. **Special Topics in Chemical Kinetics.** 2 to 4 hours. Theory and techniques in specialized areas of chemical kinetics. Prerequisite: Chem. 349 or the equivalent.
444. **Statistical Mechanics I.** 4 hours. Statistical models of systems in thermodynamic equilibrium. Offered alternate years. Prerequisite: Chem. 349.
445. **Statistical Mechanics II.** 4 hours. Statistical models of the liquid state and nonequilibrium processes. Prerequisite: Chem. 444.
446. **Quantum Chemistry I.** 4 hours. Treatment of complex atoms and molecular systems. Hartree-Fock calculations and other methods; interaction of radiation matter. Prerequisite: Chem. 406.
447. **Quantum Chemistry II.** 4 hours. Continues Chemistry 446. Prerequisite: Chem. 446.
448. **Quantum Chemistry III.** 4 hours. Continues Chemistry 447. Prerequisite: Chem. 447.
461. **Synthetic Methods of Organic Chemistry I.** 4 hours. Discussion of methods used in organic syntheses; introduction and modification of functional groups, methods of selective group protection, stereospecific processes, recent examples of applications. Prerequisite: One year of organic chemistry.
462. **Synthetic Methods of Organic Chemistry II.** 4 hours. Continues Chemistry 461. Prerequisite: Chem. 461.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Approval of the department.

## ENERGY ENGINEERING

**Professors:** James P. Hartnett, Head of the Department; Paul M. Chung, Norman A. Parker, Satish S. Saxena, Harold A. Simon

**Associate Professors:** Lyndon R. Babcock, Jr., Joseph C.F. Chow, Allen C. Cogley, David S. Hacker, John H. Kiefer, Wolodymyr J. Minkowycz, Edward S. Pierson, Stephen Szepe



**Assistant Professors:** Aemer D. Anderson, John C. Cutting, Ali G. Mansoori, Kenneth L. Uherka, Calvin J. Wolf

## Degree Requirements

A grade-point average of at least 4.000 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

### Master of Science

Forty-eight quarter hours are required for the degree, at least 16 of which must be in 400-level courses. A student may or may not submit a thesis, but in the event a thesis is submitted, 16 hours of Energy Engineering 499, Thesis Research, will be credited toward the degree. If a thesis is not written, the student must complete a research project under the guidance of an adviser from the department. This project will entail the submission of a report showing to the adviser's satisfaction the ability of the student to conduct research at the master's level. Upon completion of this project 4 hours of credit will be awarded. If the candidate submits a thesis, he is exempt from the project; however, he must, at the completion of the thesis, defend it before an examining committee.

### Doctor of Philosophy

All graduate students who plan to pursue the Ph.D. are required to pass two out of a maximum of three written cumulative examinations, which will be offered twice each year. The successful completion of these two cumulative examinations is equivalent to passing the preliminary examination. This requirement must be satisfied during the first three years of residence if the candidate enters with a bachelor's degree or during the first two years if he enters with a master's degree.

For the Ph.D. a minimum of 96 hours of course work beyond the bachelor's degree is required, of which at least 32 hours must consist of 400-level courses. The total must include a major, the scope of which is to be determined by the adviser and the graduate committee of the department, and a minor of at least 24 quarter hours. Credit in two courses from the Department of Materials Engineering and at least 12 quarter hours in courses offered by the Department of Mathematics, of which at least three hours must be at the 400 level, are required.

Reading proficiency in German, French, or Russian is required. In special cases another foreign language may be substituted if the relevance of this language to the student's major area can be convincingly demonstrated.

A major requirement of the Ph.D. program is the completion of a thesis based on a program of original research. The research is carried out and the thesis is written under the supervision of the student's adviser. The thesis must be defended before an examining committee.

## Courses for Graduate and Advanced Undergraduate Students

304. **Transport Phenomena.** 4 hours. Introduction to continuum theory of momentum, energy, and mass transfer. Transport of scalar and vector quantities. Reynolds' transport theorem. General differential equations of transport phenomena. Momentum shell balances. Energy transport. Diffusion. Couple operations: free convection, simultaneous heat and mass transfer, etc. Prerequisites: EnrE. 201 and 211.
305. **Statistical Thermodynamics.** 4 hours. Statistical formulation; partition functions, including quantum effect. Application to macroscopic systems; systems of interacting particles. Emphasis on engineering applications. Prerequisites: EnrE. 201, Math. 220 or the equivalent.
307. **Kinetic Theory of Gases and Transport Phenomena.** 4 hours. Basic concepts of kinetic theory of gases. Equations of state and their molecular interpretation. Elementary classical statistics, molecular collisions. Application of the kinetic theory to viscosity, heat conduction, and diffusion. Prerequisite: Completion of core program.
311. **Free Surface Flow.** 4 hours. Application of the fundamentals of fluid mechanics to fluids with a free surface. Channel flow and wind driven waves on the ocean's surface. Theory of gravity waves, capillary waves, and related phenomena. Prerequisites: EnrE. 212 and 214.
312. **Porous Media.** 4 hours. Mechanics of fluid flow in porous media. Steady and unsteady laminar flow in isotropic and anisotropic media. Multiphase and multilayered systems. Prerequisites: EnrE. 212 and 215.
313. **Aerodynamics of Flight.** 4 hours. Lift and drag, both subsonic and supersonic. Perturbation problems. Airfoil and slender body theories. Three-dimensional wings. Prerequisites: EnrE. 212 and 213.
314. **Propulsion.** 4 hours. Thermodynamics and fluid mechanics of air breathing engines. Performance of rockets; chemical, nuclear, and electrical. Prerequisites: EnrE. 213.
316. **Introduction to Continuum Mechanics.** 4 hours. Same as Materials Engineering 316. Cartesian tensors, kinematics of fluids and solids, conservation equations, constitutive equations for simple materials. Examples. Prerequisites: EnrE. 211 or MatE. 214, and Math. 220.
317. **Intermediate Fluid Mechanics.** 4 hours. Development of the conservation equations for a Newtonian fluid: continuity, Navier-Stokes and energy equations.

Some exact and approximate solutions of highly viscous, viscous, and inviscid flow problems. Prerequisite: Math. 220 or the equivalent.

321. **Intermediate Heat Transfer.** 4 hours. Topics in conduction, convection, and radiation heat transfer, with special emphasis on the exact solutions of the problems. Two-phase flow; heat exchanges, mass transfer cooling; rarefied gas analysis. Prerequisites: EnrE. 221 and Math. 220.
331. **Chemical Engineering Thermodynamics.** 3 hours. Review of first and second laws with subsequent applications to chemical systems. Free energy, availability, equilibrium conditions, and applications to chemical processes. Equilibrium constant, chemical potential for gas reactions, heterogeneous systems, and phase change. Prerequisite: EnrE. 201 or the equivalent.
341. **Experimental Methods and Techniques.** 4 hours. Purpose and design of experiments; statistical analysis of errors; wind tunnel, shock tube, high vacuum and chemical reactor techniques; theory of mechanical, thermal, optical, and chemical measurements.
351. **Electromechanical Energy Conversion I.** 4 hours. Conservation of energy, electromagnetic forces, applications to linear and nonlinear lumped parameter systems, stability. Principles of rotating machines and equations of motion. Applications to synchronous, induction, d-c, and novel machines. Prerequisites: InfE. 221 and credit or registration in InfE. 311.
352. **Electromechanical Energy Conversion II.** 4 hours. Continues Energy Engineering 351; completion of rotating machines. Interaction of electromagnetic fields with stationary and moving continuous media, Maxwell stress tensor, and waves and instabilities. Applications to energy conversion with emphasis on fluids (magnetohydrodynamics). Prerequisites: EnrE. 211, 351, and InfE. 320.
353. **Direct Energy Conversion.** 4 hours. Novel methods of converting heat directly into electrical energy. Consideration of magnetohydrodynamics, thermoelectrics, thermionics, and fuel cells. Prerequisites: EnrE. 202 and 352.
361. **Atmospheric Motions.** 4 hours. The equations of motion on a rotating earth and their application to dynamic meteorology. Various aspects of inertial geostrophic, gradient, and thermal winds. Atmospheric turbulence and flow in the earth's boundary layer. Diffusion of heat, water vapor, and atmospheric pollutants. Prerequisites: EnrE. 214 and 217.
391. **Seminar.** 1 to 4 hours. May be repeated for additional credit. Topics to be arranged. Prerequisite: Consent of the instructor.

## Courses for Graduate Students

401. **Classical Thermodynamics.** 4 hours. The postulatory approach to thermodynamics; entropy maximum postulate; conditions for equilibrium and stability. Property relations; reversibility; processes and cycles. Thermodynamics of elastic, magnetic, and electric systems. Prerequisite: Math. 220 or the equivalent.



402. **Thermodynamics of Multicomponent Systems. 4 hours.** Application of the first, second, and third laws to chemical engineering systems. Concepts of chemical potential and fugacity. Availability and free energy. Chemical and phase equilibria with application to multicomponent and multiphase systems. Properties near the critical point. Law of corresponding states. Problems of a chemical engineering nature. Prerequisite: EnrE. 401 or the equivalent.
404. **Irreversible Thermodynamics. 4 hours.** Irreversible systems approaching equilibrium. Method of irreversible thermodynamics; Onsager's fundamental theorem; statistical and kinetic bases of the theorem. Engineering applications: chemical and electrochemical reactions; thermal diffusion and diffusion thermophenomena; thermoelectric and thermomagnetic phenomena. Thermodynamic time. Prerequisite: EnrE. 401 or the equivalent.
405. **Advanced Statistical Thermodynamics. 4 hours.** Electromagnetic radiation, quantum mechanics of solids, diatomic and polyatomic gases, statistical mechanics of interacting particles, real gases and liquids, chemical equilibrium and irreversible processes, emphasis on the engineering applications. Prerequisite: EnrE. 305.
406. **Transport Phenomena. 4 hours.** Development of classical and statistical concepts of molecular diffusivity, conductivity, and other transport parameters. Kinetic theory of gases. Partition functions. Maxwell and Boltzmann distribution functions. Prerequisite: EnrE. 305 or the equivalent.
407. **Kinetic Theory of Nonuniform Gases I. 4 hours.** Distribution function: Boltzmann equation and its solution, two-particle collisions, inverse collisions, collision cross-sections, intermolecular forces, derivation of transport coefficients of gases, and thermal diffusion. Prerequisites: EnrE. 307 and Math. 322.
412. **Potential Flow. 4 hours.** Fluid kinematics, fundamental equations, exact and approximate solutions of the potential equation, conformal mapping, airfoil theory, and surface waves. Prerequisite: EnrE. 212 or the equivalent.
414. **Mechanics of Viscous Fluids. 4 hours.** Internal and external flows. Boundary layer analysis. Similarity solutions, integral methods, and other techniques for treating laminar and turbulent flows. Prerequisite: EnrE. 310 or the equivalent.
416. **Compressible Fluid Mechanics. 4 hours.** Conservation equations, equations of state, surface of discontinuity, one-dimensional and two-dimensional subsonic and supersonic flows, Prandtl-Mayer expansions and shock phenomena, theory of characteristics, and hodograph methods. Prerequisite: EnrE. 213 or the equivalent.
418. **Fundamentals of Turbulence. 4 hours.** Mathematical descriptions of turbulence field; kinematics of homogeneous turbulence; correlation and spectrum tensors; dynamic behavior of isotropic turbulence; universal equilibrium theory; nonisotropic turbulence; transport processes in turbulent flows. Prerequisites: EnrE. 414 or 422 and Math. 323 or the equivalent.



- 419. Nonlinear Continuum Mechanics I. 4 hours.** Same as Materials Engineering 419. Kinematics and fundamental laws of mechanics. General constitutive equations; reduced constitutive equations. Homogeneous motions of simple bodies. Isotropic group, simple fluids, simple solids, simple subfluids. Examples. Prerequisite: EnrE. 316.
- 420. Nonlinear Continuum Mechanics II. 4 hours.** Same as Materials Engineering 420. Special classes of materials. Simple fluids, viscometric flows, the Weissenberg effect. Isotropic elastic materials, exact solutions. Wave propagation. Thermodynamics. Nonlinear viscoelastic materials, polar materials, and other materials. Prerequisite: EnrE. 419.
- 421. Heat Conduction. 4 hours.** Analysis of heat conduction in solids, including the use of Fourier series, integral transforms, similarity transformations, and approximate methods. Prerequisite: Consent of the instructor.
- 422. Convective Heat Transfer. 4 hours.** Conservation equations. Momentum, heat, and mass transfer in laminar and turbulent boundary layers for internal and external flows. Convective heat transfer at high velocities. Heat transfer with change of phase. Special topics in convective heat transfer. Prerequisite: EnrE. 310 or the equivalent.
- 424. Thermal Radiation. 4 hours.** Introduction to Planck's quantum theory. Black-body radiation; Wien's law; Stephan-Boltzmann's law. Basic concepts of total and spectral emissivity, absorptivity, reflectivity, and transmissivity. Kirchhoff's law. Radiation exchange between solid surfaces; gaseous radiation; radiation-convection interaction. Prerequisite: Consent of the instructor.
- 426. Radiation Gas Dynamics. 4 hours.** Basic laws and definitions of thermal radiation. Energy transfer in absorbing, emitting, and scattering media. Thin and thick approximate methods. Radiative equilibrium. Combined conduction and radiation. Combined convection and radiation. Prerequisites: EnrE. 414 or 422, and Math. 321 or the equivalent.
- 431. Advanced Chemical Reaction Engineering. 4 hours.** Nonideal reactors; the effects of residence time distribution and mixedness. Heterogeneous noncatalytic reactions; gas-liquids, liquid-liquid, and solid-fluid systems. Heterogeneous catalytic reactions. Time dependent systems; catalyst deactivation. Prerequisite: EnrE. 386.
- 432. Molecular Theory of Gas Dynamics. 4 hours.** Kinetic theory distribution functions, Liouville theorem and Boltzmann equation. Moments of Boltzmann equation. Near-equilibrium perturbations; nonequilibrium analyses; rarefied gas flows; shock structure; nonequilibrium plasmas. Prerequisites: EnrE. 304, 310, and Math. 322 or the equivalent.
- 434. Plasma Dynamics. 4 hours.** Electromagnetic fields: Motions of charged particles; statistical description of plasmas; ionization phenomena; Landau damping; electromagnetic waves; instabilities. Prerequisite: EnrE. 432.

436. **Chemically Reacting Flows.** 4 hours. Nonequilibrium states; chemical thermodynamics and kinetics. Multicomponent continuum equations for flow of nonequilibrium fluids. Inviscid nonequilibrium flows. Boundary layer flows with surface and gas-phase reactions. Frozen and equilibrium criteria. Waves in relaxing media. Prerequisites: EnrE. 414 or 422, and 416.
438. **Separation Processes.** 4 hours. Advanced treatment of separation processes based on preferential migration. General theory. Binary and multicomponent distillation. Absorption, adsorption, and extraction processes. Gas chromatography and liquid chromatography. Dialysis, and miscellaneous other separations. Prerequisite: EnrE. 304.
440. **Non-Newtonian Fluids.** 4 hours. Constitutive equations for non-Newtonian fluids. Simple fluids. Viscoelasticity. Viscometric flows. Helical flow. Large elastic deformations, stress relaxation. Thermodynamics of viscoelastic fluids. Time-temperature superposition. Transport phenomena in non-Newtonian fluids. Experimental methods and results. Prerequisite: EnrE. 316.
451. **Kinetics of Gas Reactions.** 4 hours. Basic concepts of reaction rate and mechanism. Collision theory, absolute rate theory, and theory of unimolecular decomposition. Dissociation, recombination, and chain reactions. Combustion, flames, and detonations. Catalysis. Prerequisites: EnrE. 304 and 305.
484. **Mathematical Techniques of Nuclear Reactor Theory I.** 4 hours. Same as Mathematics 484. Introduction to nuclear physics and nuclear reactor physics; flux distributions, critical mass, slowing down kernels and their Fourier transforms, two-group steady state theory in the reflected reactor, buckling iteration method, matrix methods in boundary value and criticality problems in the one-dimensional multiregion reactor, series solutions of group diffusion equations in multiregion reactor and in two-dimensional fully reflected reactor, reactor criticality codes. Prerequisites: Math. 312, 323, 341 or 348, and 381 or the equivalents.
485. **Mathematical Techniques of Nuclear Reactor Theory II.** 4 hours. Same as Mathematics 485. Variational methods in the criticality problem, theory of control rods in cylindrical reactor, introduction to reactor kinetics, perturbation theory and applications, adjoint flux distributions, inhour equation for multi-region multifuel reactors, xenon poisoning, and override problem. Prerequisite: EnrE. 484.
486. **Mathematical Techniques of Nuclear Reactor Theory III.** 4 hours. Same as Mathematics 486. Cylindrical reactor with source, power-level determination problem, time-dependent flux distributions in multiregion reactor, one-group model, transient and stable flux distributions in multiregion reactor, two-group model, self-limiting power bursts, analysis of nonlinear feedback problems. Prerequisite: EnrE. 485.
491. **Specialized Problems.** 4 to 12 hours. Specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

493. **Current Topics of Energetics.** 4 hours. The particular topics will vary from quarter to quarter depending on the interests of the students and the specialties of the instructor teaching the course at the time. Prerequisite: Consent of the instructor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Individual research in specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

## ENGLISH

**Professors:** John C. Johnson, Head of the Department; Paul Carroll, John A. Conley, Dean B. Doner, Alexander Karanikas, Bernard R. Kogan, Jay A. Levine, Louis A. Marder, Ralph J. Mills, John F. Nims, Robert B. Ogle, Andrew Schiller, John B. Shipley, James B. Stronks, Samuel A. Weiss, Martin L. Wine, Elizabeth V. Wright

**Associate Professors:** Beverly Fields, Gloria G. Fromm, Lester S. Golub, Guinevere L. Griest, Michael Lieb, Adam Makkai, Valerie B. Makkai, Patricia McFate, A. LaVonne Ruoff, Jaroslav Schejbal (Visiting), Mary Thale, Maurita Willett

**Assistant Professors:** Preston M. Browning, Melvin H. Buxbaum, Archibald J. Byrne, Nancy R. Cirillo, Edith Gold, Hymen H. Hart, Dale S. Herron, Howard H. Kerr, David S. Lenfest, Vincent Louthan, Irving M. Miller, Sondra Rosenberg, Gerald C. Sorensen

## Degree Programs

The Department of English offers courses of study leading to the Master of Arts in English, with specializations in literature (both English and American) and in creative writing and to the Master of Arts in Linguistics.

## Admission Requirements

Applicants must hold a Bachelor of Arts or Bachelor of Science from an accredited college or university and an overall grade-point average of at least B (4.000 on a 5.000 scale) for the last 90 quarter (60 semester) hours of undergraduate study.

A student who applies for the creative writing or the literature program must present the equivalent of 36 quarter hours of English and American literature, of which 28 hours must be in English (including a course in Shakespeare) and 8 in American literature, with any additional literature courses in either. These requirements do not apply to those seeking admission to the linguistics program. Sophomore-level surveys of English or American



literature will not be counted toward the 36 hours. If a student whose undergraduate course work is deficient earns a high score on the Graduate Record Examination, he may be admitted after a favorable review by the department graduate committee. In some cases the committee may set prerequisites to be made up, without graduate credit, in the student's first quarter(s) at Chicago Circle. The passing grade for a deficiency course is B.

In exceptional circumstances, the committee may accept applicants with an average between 3.750 and 4.000. They may be admitted as regular students if their Graduate Record Examination scores and other factors warrant. Otherwise, these students and any others with an average between 3.500 and 3.750 who seem to warrant special consideration may be admitted on probation. However, the number of probationary admissions is limited.

All probationary students and all those seeking to enter any of the department programs from unassigned status in the Graduate College must present GRE scores at least at the 66th percentile rank in both the general aptitude and the advanced literature tests.

Applicants for admission to any of the graduate programs in the Department of English must submit the following, unless otherwise exempted:

An application form (accompanied by the \$15 nonrefundable application fee).

A transcript of undergraduate (and any graduate) course work.

Two letters of recommendation, preferably from professors who are familiar with the applicant's recent work.

A statement of about 250 words presenting the applicant's reasons for wishing to take graduate work in English and the relationship of his work to his professional and other goals (foreign applicants see below).

Graduate Record Examination scores for both the general aptitude and the advanced literature tests. A student who applies for admission to the linguistics program need take only the aptitude tests, though it is recommended that he submit the scores for his own special field.

Evidence of a reading knowledge of a foreign language: any of the major modern European or the classical languages (Greek or Latin). Inquire about the acceptability of other languages. This requirement may be satisfied by either of the following: (1) by presenting a grade of A or B in an upper-division (junior-senior) foreign-language literature course or (2) by presenting a score on the ETS Graduate School Foreign Language Test that is at least at the 50th percentile rank. If an otherwise qualified applicant does not present evidence of foreign-language competence, he will be admitted on limited status until he has satisfied the requirement by either of the following: (1) by passing an upper-division literature course (200- or 300-level) in a classical language or in a major modern European language (or others by petition) with a grade of A or B, or (2) by passing a reading



examination. A student must complete this requirement within the first two quarters of full-time study or before he has earned 24 quarter hours of credit.

An applicant for admission to the creative writing program, in addition to the foregoing, must submit a sample of his writing (at least five poems, a story, a chapter from a novel, or comparable work) to the staff of the Program for Writers.

A foreign applicant should submit GRE scores if it is possible for him to take the examinations. In any event, in place of the 250-word statement, he is required to submit a 4 to 5 page summary (preferably typed double space) of his educational experience, with stress on his work in English and American literature and language. The applicant should conclude this summary with his reasons for wanting to do graduate work in the United States.

## Degree Requirements

### M.A. in English

#### Specialization in Literature

*Hours:* 48 quarter hours of course work are required, including English 400, Introduction to Bibliography and Research. At least 36 of the 48 hours must be in English; the remaining 12 hours may be in courses in other departments or disciplines approved by the student's adviser.

A thesis is not required. Each student will submit one *qualifying paper*, of not less than 40 pages, for the approval of the Graduate Committee of the department. The *qualifying paper* may be an enlarged version of a paper written for a 300- or 400-level course, may have originated in independent research, or may have arisen independently of any course. The student must enroll in English 497, Independent Research, 4 hours, to write an acceptable qualifying paper.

The student must satisfy a language requirement as stated in the admission requirements.

All candidates are required to pass a master's examination given in the spring, summer, and fall. Students may take English 497 for 4 quarter hours to prepare for this examination. If a student fails the examination, he may be allowed to repeat it once.

#### Specialization in Creative Writing

*Hours:* 48 hours of course work are required, distributed as follows: at least 16 hours of 300- or 400-level literature courses (exclusive of the 300-level writing courses); English 400, Introduction to Bibliography and

Research, or English 472, Criticism Workshop; no more than 16 hours in writing workshops. The remaining 12 hours may be taken in tutorials (English 497) or in graduate-level literature courses (exclusive of 300-level writing courses) in English or in other departments, as approved by the adviser.

*Thesis:* Each student must present a thesis consisting of a publishable volume of his work, such as a volume of poems, a novel, a collection of stories, a play, etc. Groups of smaller works (such as a chapbook of poems or a group of two or three critical essays) may also be submitted. As these works are expected to grow out of the writing workshops, credit for English 499 will not be given.

A student must satisfy a language requirement, as stated in the admission requirements. Successful completion of English 473, Workshop in Translation, will satisfy this requirement.

The candidate must pass a master's examination. He may take English 497 for 4 quarter hours to prepare for this examination only at the discretion of the chairman of the Program for Writers.

### M.A. in Linguistics

*Hours:* 48 quarter hours of course work are required, including Linguistics 315, Introduction to Descriptive Linguistics, and English 400, Introduction to Bibliography and Research (in a section for linguistics students). If the student has not had a course in the history of the English language, he may be required to take English 301.

*Thesis:* All students are required to submit a thesis.

All students must satisfy a language requirement, as stated in the admission requirements. However, a student in linguistics is not limited to European languages.

All candidates must pass a comprehensive examination. The student may take English 497 for 4 quarter hours to prepare for this examination only at the discretion of the chairman of the linguistics section.

A student may select either of two programs in linguistics:

*The Applied Linguistics Program* is intended primarily for teachers of English and other languages on the secondary level. Therefore, their course work is designed to provide a general background in linguistics. The emphasis is also to some extent literary.

*The Theoretical Linguistics Program* aims to establish a firm groundwork for persons who intend to become professional linguists. Therefore, the emphasis is scientific rather than literary or pedagogical.

## Courses for Graduate and Advanced Undergraduate Students

301. **History of the English Language.** 4 hours. English in its relationship to other languages; historical account of its development. Prerequisite: 12 hours in English.
302. **Tennyson and Browning.** 4 hours. Close study of the lyric poetry and the dramatic monologues of Tennyson and Browning; briefer examination of Tennyson's Arthurian idylls and of the plays of both.
303. **Carlyle and Mill.** 4 hours. Major works.
304. **George Eliot and Trollope.** 4 hours. Close study of novels by Eliot and Trollope; their relationship to both the Victorian era and the development of the novel. Prerequisite: A minimum of 12 hours in English.
305. **Newman and Arnold.** 4 hours. The prose of one early and one mid-Victorian writer: their contributions to nineteenth-century religious and educational theories. Arnold's literary and social criticism. The rhetoric of both; brief reference to the poems and letters of each that most closely parallel ideas and moods in their prose.
306. **Dickens and Thackeray.** 4 hours. Close study of the major writings of the two representative Victorian novelists.
307. **Yeats and Eliot.** 4 hours. Detailed study of the two most influential English poets of the twentieth century. Study of specific texts; some emphasis on the intellectual and spiritual attitudes represented by each.
308. **Conrad and Lawrence.** 4 hours. Studies in the short fiction and novels of two important modern British writers; examination of their contrasting views of the purpose of fiction. Prerequisite: A minimum of 12 hours in English.
310. **American Puritanism.** 4 hours. Intensive study of the writings of the American Puritans from William Bradford to Jonathan Edwards. Major aspects of Puritan life and thought. Prerequisite: A minimum of 12 hours in English.
311. **Chaucer.** 4 hours. Readings in the major works.
312. **Introduction to Old English.** 4 hours. Elements of Old English grammar and the reading of graded prose selections. Prerequisite: 12 hours in English.
313. **Old English Poetry and Prose.** 4 hours. Heroic, elegiac, and religious poetry of England to 1200, exclusive of *Beowulf*; representative prose. Prerequisite: Engl. 312.

314. *Beowulf*. 4 hours. Detailed explication of the poem. Prerequisite: Engl. 313.
316. *American Drama*. 4 hours. Major dramatic writings in American literature.
317. *The Writing of Poetry*. 4 hours. Limited to 15 students. May be repeated for a total of 12 hours. The practice of the writing of poetry, aided by intensive study of examples. Prerequisite: 12 hours of English literature.
318. *The Aesthetic Movement from 1850 to 1900*. 4 hours. Major figures and ideas behind the Pre-Raphaelite Brotherhood and the aesthetic movement in the last half of the nineteenth century in England.
319. *Introduction to Middle English*. 4 hours. A linguistic examination of Middle English and its dialects.
321. *Medieval Literature I*. 4 hours. Selected works in Middle English and continental medieval writings in English translation. Prerequisite: A minimum of 12 hours in English.
322. *Medieval Literature II*. 4 hours. Continues English 321. Prerequisite: A minimum of 12 hours in English.
323. *Wordsworth and Coleridge*. 4 hours. Close examination of the major works, both poetry and prose. Prerequisite: A minimum of 12 hours in English, including Engl. 243 and 244.
324. *Byron, Shelley, and Keats*. 4 hours. The major figures of the second generation of Romantics.
325. *The Writing of Fiction*. 4 hours. Limited to 15 students. May be repeated for a maximum of 12 hours. The practice of the writing of fiction, aided by intensive study of examples. Prerequisite: 8 hours in English literature.
331. *Important Minor Plays and Poems of Shakespeare*. 4 hours. Plays, poems, and sonnets. Prerequisite: Engl. 231 or 232.
332. *The Poetry of Edmund Spenser*. 4 hours. Introduction to *the Faerie Queen* and *The Shepheardes Calendar*; some attention to the minor verse and its place in the English Renaissance. Prerequisite: A minimum of 12 hours in English.
334. *Literary Criticism, Theory, and Practice*. 4 hours. Survey of literary criticism, focusing on major critics from Plato to Matthew Arnold.
335. *Modern Literary Criticism*. 4 hours. Survey from Matthew Arnold to the present. Prerequisite: Engl. 334.
337. *Exercises in Literary Criticism: Poetry*. 4 hours. Advanced course in practical criticism of poetry in English. Prerequisite: Engl. 335 or the equivalent.
338. *Tragedy*. 4 hours. A formal and theoretic inquiry into tragedy: its origins, evolution, and significance, based on selected masterworks of various periods.



## ENERGY ENGINEERING

The department offers a program leading to the degree of Master of Science in Energy Engineering and, jointly with the Department of Materials Engineering, a program leading to the degree of Doctor of Philosophy in Engineering (Solids and Fluids).

These programs are broadly based to accommodate students in aerospace, chemical, mechanical, power engineering, and related fields. The primary areas upon which these fields are based are continuum and molecular fluid mechanics, heat and mass transfer, and macroscopic and microscopic thermodynamics.

After admission to the Graduate College, a temporary adviser is assigned to the student. The student, however, is required to choose a permanent adviser during the first quarter. As soon as the permanent adviser has been selected, the student should outline the complete program proposed for the degree (M.S. or Ph.D.) with the help of his adviser and the graduate committee of the department.

The Ph.D. program presently includes the following broad areas of specialization: continuum mechanics, gas dynamics, heat transfer, metallurgy, plasma dynamics, soil engineering, and structures. Of these, the Department of Energy Engineering offers study in the fields of gas dynamics, heat transfer, and plasma dynamics. Students are permitted and encouraged to follow interdisciplinary programs which may include more than one area of specialty and require taking courses in more than one department.

## Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.00 out of 5.00) or better in undergraduate study. Those with lower averages may be admitted upon recommendation of the department, provided they satisfy the minimum requirements of the Graduate College. Practicing engineers wishing to return to school for further graduate instruction may be admitted on a tentative basis if their professional experience makes it appear likely that they will be able to follow the program successfully. This tentative admission will become permanent after the completion of at least 16 quarter hours with an average of 4.00 or better.



## PHYSICS

### Admission Requirements

In addition to meeting the requirements of the Graduate College, applicants must have 30 quarter hours (20 semester hours) of courses in physics beyond the level of general physics, including Physics 301, 302, 321, and 341, or their equivalents, and a grade-point average of at least 3.75 for the last 90 quarter hours of undergraduate work. Applicants with grade-point averages below 3.75 but above 3.50 may be admitted under special circumstances. Applicants who have majored in fields other than physics and who meet the other academic requirements may be considered for admission, but they will be required to take the necessary undergraduate courses without credit in order to prepare themselves for successful participation in graduate work.





## POLITICAL SCIENCE

The department offers courses leading to the degree of Master of Arts. Students may specialize in American government or public administration. A thesis is optional. The non-thesis option requires 48 hours of course work; the thesis option requires 40 hours of course work and 8 hours of thesis research.

### Admission Requirements

Applicants must have a degree from an accredited institution of higher learning and a B average for the last two years of undergraduate work. Those with grade-point averages below 4.00 but above 3.75 will be considered in exceptional cases.

An applicant generally must present a Bachelor of Arts degree with a major in political science or with a minimum of 20 quarter hours in political science; or he may petition to be admitted by the department.

Applications for entrance with advanced graduate standing will be considered on the basis of individual preparation and merit.

All applicants are required to take the Aptitude Test and the Advanced Political Science Test of the Graduate Record Examination. Information about this examination can be obtained from the head of the Department of Political Science. Performance on this examination, undergraduate academic record, and letters of recommendation from former teachers are the three principal kinds of evidence considered in making decisions about admission and in the awarding of assistantships. It is particularly advantageous, therefore, for the prospective applicant to take this examination in the fall of his senior year.



339. **Comedy. 4 hours.** History and theory of comic drama.
340. **English and American Satire. 4 hours.** Selected writings. Prerequisite: A minimum of 12 hours in English.
341. **Dryden. 4 hours.** Individual conferences on assigned papers are required. Poems, plays, and literary criticism; emphasis on the interaction of these genres in Dryden's development.
342. **The Poetry of Milton. 4 hours.** Origins, forms, and artistic and ethical values; Milton's place in English literary history. Prerequisite: A minimum of 12 hours in English.
343. **Tudor Drama. 4 hours.** The rise of English drama from shortly after the medieval period to the building of permanent theaters in London and the death of Elizabeth; emphasis on the works of Christopher Marlowe. Prerequisite: A minimum of 12 hours in English.
344. **Stuart Drama. 4 hours.** English drama from the accession of James I to the closing of the theaters in 1642 by the Puritan "long" Parliament; emphasis on the works of Ben Jonson. Prerequisite: A minimum of 12 hours in English.
345. **The Metaphysical Poets. 4 hours.** The poetry of Donne, Herbert, Vaughan, Crashaw. Special emphasis on Donne.
347. **Restoration Drama. 4 hours.** Major dramatic works after the reopening of the public theaters in 1660; development from aristocratic Baroque tragedy and comedy to the beginnings of bourgeois sentimental drama. Dryden, Etherege, Wycherley, Congreve, Vanbrugh, Farquhar, Otway, Cibber, and others.
348. **Swift. 4 hours.** Detailed study of the works of Jonathan Swift in the light of the intellectual and aesthetic currents of the period. Prerequisite: A minimum of 12 hours in English.
349. **Johnson and Boswell. 4 hours.** Principal writings.
350. **American Transcendentalists. 4 hours.** The Transcendentalist circle in and about Concord from 1830 to 1860: Emerson and Thoreau, Alcott, Brownson, Fuller, Ripley, Parker, Channing, and others. Prerequisite: Engl. 255 or Hist. 356 or 357.
351. **English Prose of the Eighteenth Century. 4 hours.** A survey; emphasis on the development of prose styles and their relation to modes of thought. Prerequisite: A minimum of 12 hours in English.
352. **Pope. 4 hours.** Detailed study of the works of Alexander Pope in the light of the intellectual and aesthetic currents of the period.
353. **Eighteenth Century Drama. 4 hours.** Major dramatic works and trends. Steele, Addison, Rowe, Gay, Lillo, Garrick, Cumberland, Goldsmith, Sheridan, and others are studied.

355. **American Fiction from 1800 to 1860. 4 hours.** Intensive study of the background and development of traditions and themes.
357. **Studies in the Short Story. 4 hours.** The short story as a literary form; close readings of selected short stories.
365. **Readings in the Lyric II: English. 4 hours.** Selected lyrics from the thirteenth through the nineteenth centuries. Prerequisite: A minimum of 12 hours in English.
370. **Studies in Black Literature. 4 hours.** May be repeated for a maximum of 12 hours. A theme, genre, movement, or author in black literature; emphasis on American literature. Prerequisite: Senior standing or 12 hours in English. Engl. 170 is recommended.
375. **Henry James and the Technique of Fiction. 4 hours.** Development of Henry James as a novelist. Prerequisite: A minimum of 12 hours in English.
376. **W.D. Howells: Realism in Fiction and Criticism. 4 hours.** The career of William Dean Howells as a journalist, novelist, editor, and critic; his influence on the development of realism in late nineteenth and early twentieth century American literature.
377. **Naturalism in the American Novel: Dreiser, Crane, Norris, Lewis, and Others. 4 hours.** The development of the naturalistic novel; special emphasis on Dreiser and his followers.
380. **The Rise of Realism. 4 hours.** Realism in American fiction from 1850 to 1900; Old Southwest humor and local color; Twain, Howells, Crane, the early naturalists, and others. Prerequisite: Engl. 256.
382. **The Plays of Bernard Shaw. 4 hours.** A critical, social, and philosophical inquiry.
383. **Teaching English as a Second Language. 4 hours.** Same as Education 383 and Linguistics 383. The methodology of teaching English to residents of the United States who do not speak the language, especially Spanish-Americans. A brief description of the structure of American English, methods of teaching each aspect of its structure, various teaching devices and aids, special problems that may arise, and an examination of various texts. Prerequisite: Ling. 315.
385. **Faulkner and Hemingway. 4 hours.** Studies in the short stories and novels of the two writers; examination of their literary theories.
386. **Hawthorne and Melville. 4 hours.** Two major writers of the nineteenth century; detailed analysis of one major novel of each. Prerequisite: Engl. 255.
388. **Southern Fiction. 4 hours.** Major works.
389. **Walt Whitman and Emily Dickinson. 4 hours.** The poetry and major prose of Whitman; the poems of Emily Dickinson. Prerequisite: 12 hours in English.



399. **Independent Study.** 1 to 4 hours. Open only to English majors and graduate students in English. Admission to this course is only on advice of and initiated by the English Department. Individual studies under the direction of an assigned faculty member. Nature of the work is determined by the tutor on the basis of the student's needs and interests.

## Courses for Graduate Students

400. **Introduction to Bibliography and Research.** 4 hours. Required of graduate students in English. Detailed study of bibliographic tools and examination of various kinds of research papers.
405. **Seminar on Old English.** 4 hours. A topic in Old English; emphasis on literature or philology. Content varies. Prerequisite: Engl. 314 or the equivalent.
406. **Introduction to Old Norse.** 4 hours. Same as German 436. The grammar of Old Norse and the reading of selected prose and poetry. Prerequisite: A reading knowledge of some other older Germanic dialect, such as Old English, Old Saxon, or Gothic.
415. **Seminar on Middle English Literature.** 6 hours. Individual conferences on assigned papers are required. Middle English and middle Scots literature, exclusive of Chaucer. Prerequisite: A minimum of 4 hours in medieval English literature.
416. **Seminar on Chaucer.** 6 hours. Individual conferences on assigned papers are required. Chaucer's works. Content varies. Prerequisite: A minimum of 4 hours in medieval English literature.
420. **Seminar on Renaissance Literature.** 6 hours. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in Renaissance literature.
421. **Seminar on Shakespeare.** 6 hours. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. Shakespeare's works. Prerequisite: A minimum of 4 hours in Shakespeare.
422. **Seminar on Milton.** 6 hours. Individual conferences on assigned papers are required. Milton's works. Prerequisite: A minimum of 4 hours in Renaissance literature.
425. **Seminar on Restoration and Eighteenth Century Literature.** 6 hours. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in Restoration and eighteenth century literature.
430. **Seminar on Romantic Literature.** 6 hours. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic,

or movement. Content varies. Prerequisite: A minimum of 4 hours in Romantic literature.

435. **Seminar on Victorian Literature. 6 hours.** Individual conferences on assigned papers are required. One author, topic, movement, or genre. Prerequisite: A minimum of 4 hours in Victorian literature.
440. **Seminar on Modern British Literature. 6 hours.** May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in modern British literature.
445. **Seminar on American Literature. 6 hours.** May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, or movement. Content varies. Prerequisite: A minimum of 4 hours in American literature.
447. **Seminar on Black Literature. 6 hours.** May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in black literature or American literature.
455. **Teaching College English. 4 hours.** Methods, materials, and practice in teaching college composition.
470. **Program for Writers: Poetry Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of poems written by the students. Prerequisite: Admission to the Program for Writers.
471. **Program for Writers: Fiction Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of fiction written by the students. Prerequisite: Admission to the Program for Writers.
472. **Program for Writers: Criticism Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of criticism written by the students. Prerequisite: Admission to the Program for Writers.
473. **Program for Writers: Translation Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of translation by the students. Prerequisite: Admission to the Program for Writers.
474. **Program for Writers: Nonfiction Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of nonfiction written by the students. Prerequisite: Admission to the Program for Writers.
475. **Program for Writers: Experimental Writing Workshop. 4 hours.** May be repeated for a maximum of 12 hours. Emphasis on discussion of experimental writing by the students. Prerequisite: Admission to the Program for Writers.
480. **Seminar on Genres of Literature. 6 hours.** May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. A single genre, such as poetry, fiction, nonfiction, drama, or literary criticism.

481. **Seminar on Literature and Related Fields. 6 hours.** May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. The relationship between literature and such fields as the fine arts, philosophy, psychology, religion, science, and sociology. Prerequisite: A minimum of 4 hours in the area of the literature to be studied.
497. **Research in English. 2 to 8 hours.** May be repeated for a total of 16 hours. Students are assigned to this course at the discretion of the department. Independent research in English and American literature, linguistics, and creative writing.
499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Students are assigned to this course at the discretion of the department. For students involved in thesis research and writing for advanced degrees.

## GEOLOGICAL SCIENCES

**Professors:** Werner H. Baur, Head of the Department; Richard B. McCammon

**Associate Professors:** Robert E. DeMar, Helen M. McCammon (Visiting), Kelvin S. Rodolfo, Walter Sadlick

**Assistant Professors:** David W. Baker, Warren C. Forbes, Jr., Bruce G. Gladfelter, Aijaz A. Khan, August F. Koster van Groos, Zubair Saleem, Norman D. Smith

Work leading to the Master of Science is offered in these areas: crystallography, mineralogy, petrology, and geochemistry; paleontology; oceanography, sedimentology, and sedimentary geochemistry.

## Admission Requirements

Admission generally requires a minimum grade-point average of 4.000. However, the department will rely strongly on recommendations from the applicant's undergraduate professors and on the grade-point average attained in the last two years of college. Geology students with a strong background in mathematics, physics, chemistry, and biology will receive preference, although students who have degrees in other sciences may be admitted. Serious deficiencies in undergraduate training in geology or other sciences will have to be corrected during the graduate program. The program will be selected by the student and his adviser(s) to correspond with his area of specialization. Students are requested to take the Graduate Record Examination.

## Degree Requirements

*Hours:* 48 quarter hours, 24 of which must be in the area of concentration. The area of concentration may, as in evolutionary paleontology, for example, span several academic disciplines. A minimum of 16 quarter hours must be taken in 400-level courses; 8 of these should be in the area of concentration.

*Thesis:* The student must complete a written report or a thesis involving 8 quarter hours of work on an independent study or research project selected with the approval of his faculty supervisor. The department may request the student to take a comprehensive examination in his area of specialization and independent study. The independent study report or thesis will be evaluated by a department committee that will include one member selected from outside the faculty of Chicago Circle.

Candidates must demonstrate competence in reading the scientific literature of at least one foreign language. French, German, and Russian are the preferred languages.

## Courses for Graduate and Advanced Undergraduate Students

310. **Igneous and Metamorphic Petrology.** 4 hours. Discussion of petrogenesis; application of thermodynamic principles to the crystallization of rocks. Prerequisites: Chem. 114 and GeolS. 210.
315. **Sedimentology.** 4 hours. Composition, texture, and structures of sediments and sedimentary rocks. Environmental factors that control sediment genesis. Theory and techniques of modern sedimentology. Prerequisites: Chem. 114, GeolS. 215, and credit or registration in Math. 131.
316. **Invertebrate Paleontology.** 4 hours. Same as Biological Sciences 316. Phylogeny, morphology, and ecology of the fossil invertebrates. Prerequisites: GeolS. 218 and consent of the instructor.
318. **Vertebrate Paleontology.** 4 hours. Same as Biological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisites: BioS. 281 and consent of the instructor.
319. **Paleobotany.** 5 hours. Same as Biological Sciences 319. Structure, phylogeny, and stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.
320. **Analysis of Geologic Structures.** 4 hours. Elementary stress and strain relations for earth materials. Nature and origin of folds and faults. Structural petrology. Deformation of the earth's crust. Prerequisites: Math. 130 and credit or registration in Phys. 101 or 111.



330. **Environmental Geology.** 4 hours. Geological aspects of man's environment; emphasis on the earth's processes, resources, and physical properties of rocks and soils insofar as they are important to, or in some way affect, human activities. Prerequisites: Math. 132 and one year of physical sciences.
335. **Geochemistry.** 4 hours. Principles of the distribution of the elements in the earth's crust. Element partitioning between coexisting minerals; origin of the elements. Introduction to thermodynamic consideration of mineral equilibria. Prerequisite: Chem. 114.
345. **Advanced Crystallography.** 4 hours. Crystalline properties of minerals. Theory and practice of determining the crystalline structure of minerals. Prerequisite: GeolS. 300.
350. **Hydrogeology.** 4 hours. The occurrence, storage, movement, and quality of water in rocks of the earth's crust. Prerequisites: GeolS. 103 and 220; credit or concurrent registration in Math. 133.
360. **Introductory Geophysics.** 4 hours. The shape and figure of the earth, gravity, seismology, and magnetism. Thermodynamics of the earth; atmospheric and planetary geophysics. Prerequisite: Consent of the instructor.
365. **Statistical Methods in Geology.** 4 hours. Introductory course. Sampling from geological populations, statistical inference, and hypothesis testing; statistics of orientation data; trend surface methods; multivariate correlation techniques; time series analysis. Prerequisite: Math. 370.
370. **Engineering Geology.** 4 hours. Applications of geology to major engineering problems and operations. Prerequisites: GeolS. 150, 206, Math. 132, and Phys. 114.
380. **Earth Science for Teachers.** 9 hours. Survey of the earth sciences; particular attention to the Earth Science Curriculum Project (ESCP) materials. Emphasis on the interdisciplinary nature of and investigative approach toward earth science. Prerequisites: Bachelor's degree in science or mathematics, enrollment in NSF In-Service Institute for Secondary School Teachers and consent of the instructor.
385. **Geophysical Exploration.** 4 hours. Introduction to methods of geophysical exploration. Interpretation of seismic data, gravity and magnetic anomalies, and electrical and electromagnetic surveys. Laboratory includes field investigations. Prerequisites: Math. 133 and GeolS. 360.

## Courses for Graduate Students

413. **Problems in Evolutionary Paleontology.** 4 hours. Same as Biological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change, such as rates of evolution, population structure, and extinction as shown by the vertebrate fossil record. Prerequisites: GeolS. 218 and BioS. 305. Biological Sciences 345 is recommended.

420. **Advanced Vertebrate Paleontology.** 4 hours. Same as Biological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups: fishes, amphibians and reptiles, and mammals. Prerequisite: BioS. 282 and GeolS. 318.
430. **Advanced Mineralogy.** 4 hours. May be repeated if the same topic is not covered twice. Various topics in one of the following categories: structural mineralogy, X-ray crystallography, optical properties of minerals, and crystal chemistry and mineral synthesis. Lectures, seminars, and laboratory. Prerequisites: GeolS. 206 and consent of the instructor.
432. **Advanced Geochemistry.** 4 hours. May be repeated if the same category is not covered twice. Advanced topics in one of the following categories: isotope geochemistry and geochronology, distribution of elements in the earth's crust, mineral systems with and without volatile components, and low-temperature mineral systems. Lectures, seminar, and laboratory. Prerequisites: GeolS. 335 and consent of the instructor.
440. **Ground-Water Seminar.** 4 hours. Selected topics in ground-water hydrology. Prerequisites: GeolS. 350 and credit or concurrent registration in Math. 220.
460. **Marine Geology.** 4 hours. Origin and nature of marine sediments, tectonics and geomorphology of the ocean floor, including methods of mapping and measuring submarine topography. Prerequisites: GeolS. 220 and 340.
495. **Advanced Studies in Geology.** 2 to 8 hours. May be repeated twice. Independent study or research, under a faculty supervisor, culminating in a written report. Work may be taken in the following fields: stratigraphy, sedimentation, paleontology and paleoecology, vertebrate paleontology, mineralogy and petrology, crystallography, geochemistry, engineering geology, oceanography. Prerequisites: Consent of the head of the department and the faculty member who will act as study supervisor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Individual work under the supervision of faculty members in their respective fields. Prerequisites: Consent of the thesis supervisor and the head of the department.

## GERMAN

**Professors:** Robert R. Heitner, Head of the Department; Lee B. Jennings, Robert Kauf, Daniel C. McCluney, Jr., Leroy R. Shaw, Elizabeth Teichmann, Hazel C. Vardaman

**Associate Professors:** Arnold J. Hartoch, Karl F. Otto, Jr., Ernest S. Willner

**Assistant Professors:** Thomas A. Buesch, Heinz C. Christiansen, Else Huenert-Hofmann, Brian O. Murdoch, Marilyn J. Torbruegge

Work leading to the Master of Arts is offered in two areas of specialization: German literature and German philology and linguistics.

## Admission Requirements

Applicants must have a bachelor's degree with a major in German from an accredited institution or the equivalent from a foreign university. Those whose undergraduate preparation in German is deemed inadequate may be admitted at the discretion of the department but will be required to take supplementary course work on the undergraduate level. Applicants are expected to have a grade-point average of 4.000 in their undergraduate work in German; those with averages between 3.500 and 4.000 may be considered.

Entering students must have the ability to read literary and critical German with speed and accuracy and to follow class lectures in German. They should also have an elementary acquaintance with German linguistics and some knowledge of the main outlines of German literature from 1750 to the present.

## Degree Requirements

### *Program A (A thesis is not required)*

1. A minimum of 48 hours of course work, including at least 36 hours in the major field, 18 of which must be in 400-level courses.
2. At least one graduate seminar in German.
3. A one-hour oral examination and a three-hour written comprehensive examination.

### *Program B (A thesis is required)*

1. A minimum of 36 quarter hours of course work, including at least 24 hours in the major, 18 of which must be in 400-level courses.
2. At least one graduate seminar in German.
3. A master's thesis.

## Courses for Graduate and Advanced Undergraduate Students

320. **Writing and Speaking German V.** 4 hours. Prerequisite: Ger. 204 or the equivalent.
321. **Writing and Speaking German VI.** 4 hours. Prerequisite: Ger. 320 or the equivalent.
370. **The German Novelle.** 4 hours. Reading and interpretation of representative *Novellen* of the nineteenth and twentieth centuries. Prerequisites: Ger. 221 and two additional German literature courses.
372. **German Drama.** 4 hours. Development from the Enlightenment to the present. Prerequisites: Ger. 221 and two additional German literature courses.

374. **Poetry from the Seventeenth Century to the Present.** 4 hours. Prerequisites: Ger. 221 and two additional German literature courses.
380. **Goethe's *Faust*.** 4 hours. Intensive study of Parts I and II. Prerequisites: Ger. 221 and two additional German literature courses.
382. **German Literature to 1750.** 4 hours. Prerequisites: Ger. 221 and two additional German literature courses.
385. **Germanic Linguistics.** 4 hours. Linguistic geography, *Sprachschichten*, and principles of structural linguistics. Prerequisite: Ger. 203 or the equivalent.
390. **Topics in German Literature.** 4 hours. May be taken more than once for credit. Reading and discussion of the work of one prominent German author or of a group of related authors. Subject varies and is chosen by the instructor. Prerequisites: Ger. 290, 292, and 294.

## Courses for Graduate Students

404. **Theories of German Phonetics and Phonology.** 4 hours. Introduction to phonological and phonetical analysis of the German language. Prerequisite: Consent of the instructor.
405. **History of the German Language.** 4 hours. Structural and lexical development.
407. **Teaching Methods for Graduate Assistants.** 1 hour. May be repeated twice for credit. Prerequisite: Appointment as a teaching assistant in German.
408. **Bibliography and Research Methods.** 4 hours.
410. **Middle High German.** 4 hours.
420. **Medieval Literature.** 4 hours. German literature from 1100 to 1400. Prerequisites: Ger. 382 and 410 or the equivalents.
421. **Renaissance and Reformation Literature.** 4 hours. Prerequisite: Ger. 382 or the equivalent.
422. **Baroque Literature.** 4 hours. Prerequisite: Ger. 382 or the equivalent.
423. **Enlightenment and *Sturm und Drang* Literature.** 4 hours.
425. **Goethe and Schiller—The Weimar Period.** 4 hours.
426. **Romanticism.** 4 hours. Literature, theories, and philosophy of eighteenth and nineteenth century German Romanticism.
427. **Poetic Realism.** 4 hours. German literature between Romanticism and Naturalism.



428. **Modern German Literature from 1890 to 1930.** 4 hours.
429. **Contemporary Literature.** 4 hours. German drama, lyric and narrative prose from 1930 to the present.
432. **Old High German.** 4 hours. Introduction to sounds, morphology, and syntax. Reading of Old High German literary texts. Prerequisite: Ger. 405.
433. **Old Saxon.** 4 hours. Introduction to sounds, morphology, and syntax. Reading of Old Saxon literary texts. Comparison of Old Saxon, Old English, and Old High German. Prerequisite: Ger. 405.
434. **Gothic.** 4 hours. Introduction to sounds, morphology, and syntax. Reading of Gothic literary texts. Prerequisite: Ger. 405.
436. **Introduction to Old Norse.** 4 hours. Same as English 406. The grammar of Old Norse and the reading of selected prose and poetry. Prerequisite: A reading knowledge of some other older Germanic dialect such as Old English, Old Saxon, or Gothic.
440. **Seminar in Literature.** 4 hours. May be repeated for credit. Topics will vary. Prerequisite: Consent of the instructor.
441. **Seminar in Linguistics.** 4 hours. May be repeated for credit. Topics will vary. Prerequisite: Consent of the instructor.
447. **Laboratory Measurement of Phonetics.** 4 hours. Electroacoustic analysis of spoken German by means of special instruments for automatic graphic recording in the German Linguistic Research Laboratory. Prerequisites: Ger. 404 and consent of the instructor.
448. **The Structure of Modern German.** 4 hours. Structural analysis of modern High German by means of modern European and American methods. Prerequisites: Ger. 385 and 405.
490. **Independent Study for Graduate Students.** 1 to 16 hours. Prerequisite: Consent of the instructor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Approval of the department.

## HISTORY

**Professors:** Edward C. Thaden, Chairman of the Department; Shirley A. Bill, Bentley Gilbert, Louis Gottschalk (Visiting), Peter d'A. Jones, Stanley Mellon, Robert L. Nicholson, Robert V. Remini, Max Savelle (Visiting), John B. Wolf

**Associate Professors:** James Cracraft, Carolyn A. Edie, Robert L. Hess, Melvin G. Holli, George Huppert, Richard Jensen, Ronald Legon, Peter McKeon, Richard Millman, Karl A. Schleunes

**Assistant Professors:** Ira Berlin, Burton J. Bledstein, Robert E. Conrad, Gerald A. Danzer, Arthur Donovan, William A. Hoisington, David Jordan, Charles R. McKirdy, Marion S. Miller (Visiting), David S. Patterson, Michael Perman, James J. Robbins, Peter Stanley, Joan Scott

The Department of History offers work leading to the Master of Arts and the Doctor of Philosophy.

### Admission Requirements

Applicants must have a grade-point average of at least 4.000 for the last 90 quarter hours of undergraduate study. Students with averages below 4.000 but above 3.750 are considered on an individual basis. Three letters of recommendation from former professors are required of all applicants. Students are urged to take the Graduate Record Examination, although it is not required.

*Hours:* A student must present a Bachelor of Arts with a major in history or with a minimum of 24 quarter hours in history or he may petition the department for admission. Only in the most exceptional cases will part-time students be admitted as Master of Arts candidates. (Full time is defined as 12 or more quarter hours.) The department may require a candidate to make up any deficiencies in his preparation before granting him full standing in the graduate program. A minimum of two years of undergraduate training in a foreign language is required.

### Degree Requirements

#### Master of Arts

The candidate must pass a comprehensive examination in one major field and two minor fields selected from among the following areas of specialization: the ancient world, medieval Europe, early modern Europe, modern

Europe, Russia, Great Britain, America (United States), Africa, imperialism and colonialism, and historiography. Candidates are expected to take at least 12 hours in each of two of these fields of specialization. A minimum of 48 quarter hours is required for the degree, 16 of which must be at the 400 level. Of these 16 hours, 12 must be in history courses. A student who has done graduate work in a recognized institution without receiving a degree may petition to receive credit by examination. A thesis is not required. The candidate must pass a reading examination in a foreign language relevant to his program of study. The language presented to meet this requirement must be approved by the department. For work in certain fields, a reading knowledge of the particular language or languages relevant to that field may be required.\* With the approval of the department a student may take a minor in another discipline.

The candidate must maintain an average of at least 4.000. No credit toward the degree will be given for any course in which the student receives a grade of less than B.

### The Master of Arts Program for Teachers

The Master of Arts in History includes a special program designed to meet the needs of high school and junior college teachers. It provides a wide exposure to history, an understanding of historical methodology and practice, and preparation in a field outside history. The program emphasizes the development of teaching strategies and instructional materials. A person who enters the program without professional certification for high school teaching may gain certification through additional work. Such arrangements must be made in advance. Part-time study is permitted in this program.

The candidate must present 48 hours of course work and pass written examinations in a major field and two minor fields. The major field may be selected from the following: the ancient world, medieval Europe, early modern Europe, modern Europe, Russia, Great Britain, Asia, Africa, United States, Latin America, or world history. The minor fields, one of which will ordinarily be taken outside the department, will be developed in consultation with an adviser. A candidate normally will take at least 12 hours in each of his fields. In addition, he must present 12 hours of work in a special colloquium in American, European, and world history. Candidates are required to take 24 hours in history at the 400 level. A thesis is not required. There is no language requirement. A student who has done graduate work in a recognized institution without receiving a degree may petition to receive credit for that work. The candidate must maintain an average of at least 4.000. No credit toward the degree will be given for any course in which the student receives a grade of less than B.

\*Students who plan to transfer to another school to continue graduate work beyond the M.A. are advised to check the foreign language requirements of that school.

## Doctor of Philosophy

The department offers work leading to the doctorate in the fields of European and American history.

The doctorate in history represents mastery of several general areas of historical knowledge and calls for an original contribution to scholarship through independent study and research. Ordinarily, the candidate will complete a minimum of 48 quarter hours of graduate courses and seminars beyond the master's degree.

The requirement of the Graduate College for the doctorate is 96 quarter hours of work beyond the Master of Arts. A student may expect to take approximately 48 quarter hours of thesis research.

Unless the candidate holds a Master of Arts from the University of Illinois at Chicago Circle or from an accredited institution and has been recommended for further advanced study, he will be expected to take a qualifying examination for the M.A. The candidate for the degree must also stand for oral and written preliminary examinations. Lastly, he must present an acceptable dissertation and defend it in a final oral examination.

All new applicants for the Ph.D. at Chicago Circle will be evaluated by relevant professors after the completion of the first quarter. The department may require a student to take an oral examination at that time.

All Ph.D. candidates must have a reading knowledge of two foreign languages. In many fields of history command of a foreign language is indispensable for advanced study and research, and it is expected that that language will be used in course and seminar work as required. In some fields it is recognized that other tools, such as statistical theory, may be equally indispensable.

The program of study for each candidate will be fixed by the candidate and his adviser with the approval of the Graduate Advisory Committee of the Department of History.

Candidates must offer one major field of preparation and three minor fields, one of which may be outside the department, for the preliminary examinations. Two of the minor fields must be either geographically or chronologically outside the areas of his major field. The major fields of study offered by the department are: European history from 1450 to 1815, European history since 1648, American history from 1500 to 1877, American history since 1765, Russian history, British history since 1688, modern Italian history, and French history. Minor fields in European history are the Age of Enlightenment, diplomatic history since 1648, Bourbon France, revolutionary and Napoleonic France, Italy since 1789, intellectual history since 1815, Great Britain since 1837, imperialism and colonialism, historiography; in American history, the fields are economic history, Negro history, political parties, urban history, early national period, the Jacksonian Era, the Civil War and Reconstruction, the progressive era, and contemporary United States. Fields other than those listed may be accepted in individual cases. The work that a candidate may offer in other departments shall be determined in consultation with his adviser.



*Urban Studies and Negro History.* Graduate students will have an opportunity to pursue research in American urban studies and Negro history in the University's Urban History Manuscript Collection, a rich repository of materials dealing with the social, economic, and political history of the United States and particularly with the history of the metropolitan Chicago area. Through the materials in this collection, students in history will be trained in the use of manuscripts as well as other primary materials employed in the study and writing of history.

## Courses for Graduate and Advanced Undergraduate Students

**Note:** Graduate students must have background or training appropriate to the content of any 300-level course.

302. **Topics in Greek History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of ancient history.
303. **Topics in Roman History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of ancient history.
306. **Topics in Medieval History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of medieval history.
309. **Topics in the Renaissance.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
311. **Topics in Sixteenth Century European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
312. **Topics in Seventeenth Century European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
313. **Topics in Eighteenth Century European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
314. **Topics in Nineteenth Century European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
316. **Topics in Twentieth Century European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

318. **Topics in German History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
321. **Topics in British History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
324. **Topics in French History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
329. **Topics in Italian History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
333. **Topics in Eastern European History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
335. **Topics in Russian History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.
341. **Topics in African History.** 4 hours. Individual conferences on assigned papers are required. Study in depth of specific problems of internal African history, with concentration on such topics as the African role in the slave trade, the growth and decline of African states, African syntheses with European culture, or the African reaction to European domination and conquest. Prerequisite: 4 hours of African history.
351. **Topics in Colonial American History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.
352. **Topics in Revolutionary and Early National United States History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.
353. **Topics in Nineteenth Century United States History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.
354. **Topics in Twentieth Century United States History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.
386. **Topics in Race, Ethnic, and Minority History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

388. **Topics in Economic History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
389. **Topics in Urban History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
390. **Topics in Diplomatic History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
391. **Topics in Constitutional History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
392. **Topics in Intellectual History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
393. **Topics in Historiography.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
394. **Topics in Folklore-History Relations.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
395. **Topics in Religious History.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
396. **Topics in the History of Science.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.
397. **Topics in the History of Technology.** 4 hours. May be repeated for credit. Individual conferences on assigned papers are required. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

## Courses for Graduate Students

**Note:** Seminars are generally offered in two-quarter or three-quarter sequences. Several seminar sections are offered in European, American, and British research topics each year. Students may enroll in more than one section.

400. **Colloquium for Teachers of History.** 4 hours. May be repeated for credit. Reading and discussion of significant primary and secondary sources; investigation and development of instructional materials and techniques. Prerequisite: Consent of the instructor.

413. **Seminar on Ancient History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.
417. **Seminar on Medieval History. 4 hours.**
418. **Seminar on Renaissance History. 4 hours.**
420. **Colloquium on European History. 4 hours.** Reading in topics on European history. Prerequisite: Consent of the instructor.
421. **Seminar on European History. 4 hours.**
427. **Colloquium on African History. 4 hours.** Introduction to the literature of African history. Prerequisite: 8 hours of African history.
428. **Seminar on African History. 4 hours.**
429. **Seminar on Russian History. 4 hours.**
430. **Colloquium on Russian History. 4 hours.** Reading in topics on Russian history. Prerequisite: Consent of the instructor.
432. **Colloquium on British History. 4 hours.** Reading in topics on British history. Prerequisite: Consent of the instructor.
433. **Seminar on British History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.
450. **Colloquium on American History. 4 hours.** Reading in topics in American history. Prerequisite: Consent of the instructor.
451. **Seminar on American History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.
452. **Seminar on Urban History. 4 hours.**
479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology. 2 hours.** May be repeated. Same as Philosophy 479 and Psychology 479. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.
491. **Historical Methods. 4 hours.** A laboratory course to provide an understanding of the study of history and practical application of the methods by which the past is reconstructed.
492. **Historiography. 4 hours.** Great historians from early times to the present.



- 497. **Research and Writing.** 0 to 12 hours. Special problems in research and individual guidance in the preparation of master's research essays.
- 498. **Independent study.** 0 to 12 hours.
- 499. **Thesis Research.** 0 to 16 hours. May be repeated for credit.

## INFORMATION ENGINEERING

**Professors:** James W. Dow, Leon H. Fisher, Philip Parzen

**Associate Professors:** Robert C. Arzbaeher, Kurt Burian, Earl E. Gose, Chu Quon Lee, Chathilingath K. Sanathanan, Herbert J. Stein, Piergiorgio L.E. Uslenghi, Bert L. Zuber

**Assistant Professors:** Yun-Leei Chiou, Roger C. Conant, Rucelle L. Consigny, Robert A. Dell, John D. Ferguson, Hitoshi Inada, Philip L. Katz, Sharadbabu R. Laxpati, Jeffrey Levett, Tadao Murata, Miljenko Orsic, Roland Priemer, Howard F. Prosser, Thomas M. Smith, Stephen Tsai

**Instructors:** Robert A. Dell, Jr., Philip L. Katz

The department offers a program leading to the Master of Science in Information Engineering and, jointly with the Bioengineering Program, a Master of Science in Bioengineering.

### Admission Requirements

Applicants should have a grade-point average of B (4.000) or better for the last 90 quarter hours of undergraduate work. Applicants with grade-point averages between 3.500 and 4.000 may be admitted upon special recommendation of the department. Practicing engineers who wish to return to school for further graduate instruction may be admitted on a tentative basis if their professional experience makes it appear likely that they will succeed in the program. This tentative admission will be made permanent after the completion of at least 16 quarter hours with a grade-point average of 4.000 or better.

### Master of Science in Information Engineering

Specialization in information engineering allows a broad choice of topics, including circuit theory, electromagnetic field theory, communication theory, automatic control theory, solid state electronics, and computer science. This program is similar to that in electrical engineering elsewhere and is offered for

graduates of information engineering-oriented curricula at the University of Illinois at Chicago Circle and for graduates of electrical engineering or similar curricula elsewhere. Graduates of other scientifically oriented curricula may be admitted if they have the background to profit from graduate work in this field.

### Degree Requirements

A grade-point average of at least 4.000 is required for the Master of Science. No credit is given for any course in which a grade of less than C has been obtained. For graduation, 48 quarter hours are required, with the following additional minimum requirements:

The successful completion of a thesis, research project, design project, or extensive reading assignment to be followed by a written report and an oral examination, for which the student will receive credit for at least 4 and not more than 16 quarter hours.

The completion of at least 20 quarter hours (including thesis credit) in information engineering courses at the 400 level, including Information Engineering 410, Advanced Linear Systems, and 420, Electromagnetic Field Theory.

### Master of Science in Bioengineering

Specialization in bioengineering trains the student in the application of engineering concepts and methods to the life sciences and medicine. Areas covered include: the application of the principles of information processing communication and control theory to living systems; cybernetics, artificial intelligence and pattern recognition; bioinstrumentation, prostheses and artificial organs; and some aspects of biophysics. This program is offered for graduates of life sciences, physical sciences, or engineering curricula. Students from the life sciences are expected to emphasize mathematics, engineering, and physical sciences in their initial course work; students from the physical sciences are expected to concentrate initially on the life sciences. Bioengineering course work is offered through the Department of Information Engineering.

### Degree Requirements

Degree requirements are identical to those for students specializing in information engineering except that bioengineering students must complete at least 28 quarter hours of graduate courses in the College of Engineering, at least 20 of which (including thesis credit) shall be in information engineering courses at the 400 level. Information Engineering 410 and 420 are not required of students who specialize in bioengineering.

## Courses for Graduate and Advanced Undergraduate Students

307. **Cybernetics I.** 4 hours. Same as Systems Engineering 307. Introduction to artificial intelligence and pattern recognition by computer. Programs for playing games, proving theorems, answering questions, and making medical diagnoses. Property selection and decision making techniques. Prerequisites: Math. 195 and either 250 or 370.
311. **Linear Systems Analysis.** 4 hours. No graduate credit for majors in information engineering. Application of signal representations discussed in Information Engineering 212 to the analysis of linear systems; transform methods and frequency analysis; natural response, stability; signal flow graphs; Laplace transform with two variables; convolution integral and applications. Prerequisite: InfE. 212.
312. **Introduction to Communication Engineering.** 4 hours. Communication systems; amplitude, frequency, and pulse-type modulation; correlation and correlation functions; noise and noise calculations; channel capacity and bandwidth signal to noise ratio applications. Prerequisites: InfE. 311 and 340.
315. **Intermediate Network Analysis.** 4 hours. Network theorems; introduction to topological approaches in general linear network analysis; loop, node, and state variable equations; network functions; the positive and real concept. Prerequisite: InfE. 311.
316. **Introduction to Network Synthesis.** 4 hours. Continues Information Engineering 315. Covers positive real functions, L-C synthesis, RC, RL, and RLC synthesis, and filter design. Individual projects are required. Prerequisite: InfE. 315.
320. **Introductory Wave Propagation and Transmission.** 5 hours. No graduate credit for majors in information engineering. Transmission line theory and introduction to waveguides; elementary antenna theory. Prerequisite: InfE. 221.
324. **Wave Propagation and Radiation I.** 4 hours. Maxwell's equations and electromagnetic waves. Analysis of wave propagation in rectangular and circular waveguides. Reduction of waveguide discontinuity problems to equivalent network problems. Prerequisites: InfE. 311 and 320.
325. **Wave Propagation and Radiation II.** 4 hours. Antennas and radiating systems. Radiation from a quarter-wave monopole or half-wave dipole. Antenna impedance. Directional characteristics of antennas. Antenna practice and design. Prerequisite: InfE. 324.
326. **Wave Propagation and Radiation III.** 4 hours. Motion of charged particles in fields. Principles of klystrons, magnetrons, and traveling wave tubes. Introduction to solid state parametric devices. Prerequisite: InfE. 325.
330. **Communication Theory I.** 4 hours. With Information Engineering 31, an introduction to statistical communication theory. Signal spectra, modulation, noise, probability theory; applications of statistics to communication systems. Prerequisite: InfE. 312.



331. **Communication Theory II.** 4 hours. Continues Information Engineering 330. Individual projects are required. Prerequisite: InfE. 330.
340. **Intermediate Electronics.** 4 hours. Continues Information Engineering 240. No graduate credit for majors in information engineering. Applications of tubes, transistors, and semiconductor diodes; practical laboratory experience. Prerequisite: InfE. 240.
342. **Solid State Electronics.** 4 hours. Semiconductor physics and semiconductor circuits. Physics and circuit properties of transistors, semiconductor diodes, and other semiconductor devices; practical laboratory experience. Prerequisite: InfE. 340.
344. **Electronic Applications I.** 4 hours. With Information Engineering 345, a discussion of devices and circuits involved in pulse, digital, and switching waveforms. Prerequisite: InfE. 340.
345. **Electronic Applications II.** 4 hours. Continues Information Engineering 344. Prerequisite: InfE. 344 and credit or registration in InfE. 342.
347. **Thin Film Devices.** 4 hours. Introduction to vacuum technology. Methods of fabrication of films; sputtering, evaporation, electron beam evaporation, and chemical deposition. Physical properties of films. Application of films; resistor, capacitor, transistor, diode, magnetic memory devices, and superconductors. Prerequisites: InfE. 342 and MatE. 230.
350. **Prostheses and Artificial Organs.** 4 hours. The special problems encountered in the design of organ replacements as engineering devices. Sub-organ replacements, circulatory assist devices, artificial kidneys and other organ systems. Prerequisites: InfE. 200, 383, 384, MatE. 230, and EnrE. 211; or the equivalents.
352. **Biocontrol.** 3 hours. Demonstration of the applicability of the control systems theory to physiological systems, including the pupil system, eye and hand movement systems, utilizing techniques such as Fourier analysis, Nyquist stability criteria and cross-correlation. Prerequisites: InfE. 311, and 383 or 384.
353. **Biocontrol Laboratory.** 3 hours. Experimental counterpart of Information Engineering 352. Motor coordination, crayfish photoreceptor, human pupil, eye movement. Prerequisite: Credit or registration in InfE. 352.
354. **Bioinstrumentation: Transducers.** 4 hours. Consideration of energy conversion; detailed discussion of transducers used in biological research. Prerequisites: InfE. 240 and 311.
360. **Automatic Control Theory I.** 4 hours. Introductory mathematical preliminaries of control systems. Concept of feedback; transfer functions of typical electrical, mechanical, and hydraulic control systems; state variable representation of systems; signal flow graphs; implications of feedback on system performance; time domain analysis; stability concepts including Lyapunov, Routh-Hurwitz, and Nyquist stability criteria. Laboratory assignments include experimental determination of the response of typical control systems and analog computer simulations. Prerequisite: InfE. 311 or SysE. 312.



361. **Automatic Control Theory II.** 4 hours. Continues Information Engineering 360. Introduction to the design of feedback control systems, frequency response methods, root locus, Nichols chart, compensation techniques; modern control theory, matrix representation of linear systems and mode interpretations, concepts of controllability and observability; and linear time-varying systems. Projects involving intensive studies on servo systems and extensive simulations on digital or analog computers. Prerequisite: InfE. 360.
371. **Computer Structure and Language.** 4 hours. Computer structure and machine language, addressing techniques, components and circuits to execute the machine language instructions, digital representation of data, symbolic coding and programming techniques, computer system organization. Prerequisites: InfE. 340; Math. 195 and 340.
372. **Discrete Mathematics in Computer Design.** 3 hours. Basic set algebra, algebraic structures, Boolean algebra and propositional logic, and their applications to the design of switching circuits, graph theory, and applications. Prerequisite: InfE. 371.
373. **Switching Theory and Applications.** 3 hours. Nondecimal number systems; error correcting and other codes, analysis of gating components and networks, truth tables, combinational networks, threshold logic, regular expressions, synthesis of sequential circuits, iterative and symmetric network. Prerequisite: InfE. 372.
379. **Real-Time Data Processing.** 4 hours. Theory and techniques of data processing using analog and digital computers. Emphasis on the unique computational problems presented by biological data, illustrating the practical use of communication theory. Prerequisites: Math. 195 and 220.
383. **Animal Physiology I.** 5 hours. Same as Biological Sciences 363. The role of the digestive, circulatory, respiratory, and osmoexcretory systems in the maintenance of organismic homeostasis. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: InfE. 284.
384. **Animal Physiology II.** 5 hours. Same as Biological Sciences 364. The role of the muscular, sensory, nervous, and endocrine systems in the maintenance of organismic integration. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: InfE. 284.
391. **Seminar.** 1 to 4 hours. Topics to be arranged.
393. **Special Problems.** 2 to 4 hours. May be repeated for credit. Special problems or reading by arrangement with the faculty.

## Courses for Graduate Students

408. **Cybernetics II.** 4 hours. Comparison of natural and artificial intelligence and pattern recognition. Information processing in nets. Image processing, . Models of retinal and brain structure, thought, learning, and memory. Prerequisite: InfE. 307.

409. **Pattern Recognition Techniques and Systems.** 4 hours. Functions and systems of functions, such as machines that are designed to learn the common properties of a set of N-dimensional vectors of patterns representing samples of a class, and to recognize a new vector as a possible member of the class by noting that it has properties common to those of the set of sample vectors. Prerequisites: SysE. 372 and 451 or InfE. 307.
410. **Advanced Linear Analysis.** 4 hours. Analysis of linear networks and systems in the time and frequency domains. Basis of loop and node equations. Signal flow graphs, transform methods, state variable representation, stability. Prerequisites: InfE. 311 and credit or registration in Math. 30.
412. **Network Synthesis I.** 3 hours. Conventional methods of passive network synthesis. Positive real functions. Synthesis of LC, RC, RL, and RLC one-ports. Transfer function synthesis and insertion-loss synthesis. Prerequisites: InfE. 316 and credit or registration in Math. 330.
413. **Network Synthesis II.** 3 hours. Active network synthesis. Properties and practical realization of active and nonreciprocal network elements. Synthesis of active RC networks with NIC and controlled sources. Prerequisite: InfE. 412.
414. **Network Synthesis III.** 3 hours. Approximation methods of network functions in both frequency and time domain. Practical filter design. N-port network synthesis. Current topics on network synthesis. Prerequisite: InfE. 413.
415. **Network Topology.** 4 hours. Network theoretic graph theory; tree, incidence, circuit and cut-set matrices and their properties; topological analysis and synthesis of electrical and transport network; role of network topology in computer-aided network analysis and design. Prerequisite: InfE. 410.
420. **Electromagnetic Field Theory.** 4 hours. Transmission lines, guided waves, radiation from antennas. Prerequisites: InfE. 324 and credit or registration in Math. 330.
421. **Advanced Electromagnetic Field Theory.** 4 hours. Advanced study of electromagnetic field concepts, including uniqueness and reciprocity theorems, Huyghen's and Babinet's principles, reaction concept, variational methods, and applications to several coordinate systems. Prerequisite: InfE. 420.
422. **Advanced Microwave Theory.** 4 hours. General solution for fields in waveguides of arbitrary cross section. Microwave network analysis. Microwave devices, microwave cavities, and microwave filters. Prerequisite: InfE. 420.
423. **Antenna Theory and Design.** 4 hours. Theory and design of antennas and radiating systems. Analysis of linear, circular, and helical radiation elements. Reciprocity theorems. Antenna arrays. Slot, horn, and reflector type antennas. Prerequisites: InfE. 325 and 420.
430. **Advanced Communication Theory I.** 4 hours. Beginning graduate course in modern communication theory. Review of probability theory, random waveforms, optimum receiver principle. Prerequisite: InfE. 331.

431. **Advanced Communication Theory II. 4 hours.** Continues Information Engineering 430. Efficient signaling for message sequences and implementation of coded systems. Prerequisite: InfE. 430.
432. **Advanced Communication Theory III. 4 hours.** Continues Information Engineering 431. Channel models, filter-signal channel, bandpass channel, fading channel. Linear modulation, twisted modulation, frequency modulation, channel capacity, pulse-code modulation. Prerequisite: InfE. 431.
439. **Seminar in Behavior and Information Theory. 3 hours.** Topics in the application of information theory to behavior; emphasis on infra-human behavior. Prerequisite: Math. 370 or InfE. 408 or Psch. 470.
440. **Solid State Device Theory. 4 hours.** Study of electrical phenomena in solids, using quantum mechanics. Semiconductors, p-n junctions, transistors. Hall effect, thermal and optical effects. Prerequisites: InfE. 342 and Phys. 321.
441. **Integrated Solid State Devices. 4 hours.** Applications of solid state theory to modern integrated circuits. Active and passive semiconductors, active and passive functional blocks, MOS and thin film devices. Prerequisites: InfE. 316 and 440.
451. **Advanced Biocontrol. 3 hours.** Mathematical modeling and analysis of biological systems, emphasizing techniques of control engineering. Prerequisite: InfE. 353.
452. **Advanced Biocontrol Laboratory. 3 hours.** Laboratory experiments in conjunction with Information Engineering 451. Experience with control systems of pupil, eye movement, sensory motor coordination. Prerequisite: Credit or registration in InfE. 451.
453. **Advanced Systems Physiology. 3 hours.** Intensive treatment of selected neurophysiological topics; emphasis on systems organization. Prerequisite: InfE. 353.
454. **Advanced Systems Physiology Laboratory. 2 hours.** Coding in the frog's retina using microelectrode techniques. Prerequisite: InfE. 453.
457. **Analysis of Visual Systems. 4 hours.** An advanced course covering in detail important research areas of the visual system. The fundamental importance of physical, chemical, and physiological processes as related to vision is stressed. Prerequisite: InfE. 453.
460. **Advanced Control Theory. 4 hours.** Analysis of multivariable, multiloop control systems. Advanced topics in state space, time varying and distributed parameter systems, stability, controllability, and observability. Introduction to adaptive control. Various computer applications. Prerequisite: InfE. 361.
461. **Nonlinear Control. 4 hours.** Classification of nonlinear phenomena, linear and piecewise linear approximations. The describing function and on-off servomechanisms, phase plane techniques, limit cycle, stability concepts. Use of analog, digital, and hybrid computers for simulation. Prerequisite: InfE. 361.

462. **Synthesis Techniques in Linear Control.** 4 hours. Design principles. Cascade compensation using root locus, polar and log plots, feedback compensation. Applications in electrical, electromechanical, and fluid control. Mitrovic's parameter plane methods. Prerequisite: InfE. 361.
463. **Statistical and Sampled Data Control.** 4 hours. Basic principles of statistical design; random signals in a control system; properties of correlation function; optimality. Wiener-Hopf equation. Design of systems with constraints. Introduction to sampled data control; the sampling process; Z transform methods; stability, time and frequency response, compensation techniques. Prerequisites: InfE. 330 and 361.
470. **Automata Theory.** 4 hours. Definition and representation, equivalent states, congruence relations, decision problems of finite automata, the halting problem, state assignment problem, partitions, growing automata, probabilistic automata, self-repairing and self-reproducing systems. Prerequisite: InfE. 373.
471. **Advanced Switching Theory.** 4 hours. Principles of sequential circuit synthesis, structure of combinational switching circuits, the covering problem, multiple output and multilevel combinational circuits, bilateral switching networks, speed independent switching circuit theory. Prerequisite: InfE. 373.
472. **Hybrid Computation Theory and Techniques.** 4 hours. Basic characteristics of analog and digital computers, nature of problems best suited for analog, digital, and hybrid computers, organization of a hybrid computer, analog digital conversion, hybrid computing techniques with examples from different disciplines. Prerequisite: InfE. 373.
484. **Bioinstrumentation: Systems.** 3 hours. Analysis of systems used in biological and medical instrumentation. General principles and specific electrical, mechanical, and optical aspects of instrumentation systems.
495. **Individual Research.** 2 to 4 hours. May be repeated. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.
498. **Seminar in Bioengineering.** 1 to 4 hours. May be repeated. Systematic review of special topics; emphasis on current research. Prerequisite: Consent of the instructor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Thesis work under the supervision of a graduate adviser.



## MATERIALS ENGINEERING

**Professors:** Ernest F. Masur, Head of the Department; Thomas H. Blewitt, David W. Levinson, William Rostoker, John A. Schey, Thomas C.T. Ting

**Associate Professors:** Robert F. Domagala, James M. Doyle, Gordon H. Geiger, Daniel F. Schoeberle, Albert B. Schultz, Surendra P. Shah, Otto E. Widera, Chien H. Wu

**Assistant Professors:** Ted B. Belytschko, Graham M. Brown, Robert H. Bryant, Donald G. Lemke, Thomas M. Mulcahy, Charles A. Moore, Marshall Silver, Michael J. Weins

The department offers a program leading to the Master of Science in Mechanics and Materials. Jointly with the Department of Energy Engineering it offers a program leading to the Doctor of Philosophy in Engineering (Solids and Fluids).

The M.S. program covers a broad range of topics and may be used either as a terminal program for those planning to seek employment after obtaining the degree or as a basis for further studies. The courses offered within this program are relevant to many professional disciplines. Because of extensive freedom in course selection, a student may prepare himself for a career in such diverse areas of concentration as metallurgy, soil mechanics and foundations, structures (including concrete technology), and engineering mechanics. Interdisciplinary programs are permitted and encouraged.

After admission to the Graduate College the student selects a departmental adviser with whom a tentative course program is planned. This may be revised periodically in consultation with the adviser. Moreover, the student is free to change his adviser if he feels that such a change may be useful in the pursuit of his particular specialty.

The department does not have prescribed study programs or required courses. The selection of courses is therefore entirely up to the student and his adviser; however, satisfaction of the degree requirements requires departmental verification.

The joint Ph.D. program includes several areas of specialization, of which the Department of Materials Engineering covers the fields of continuum mechanics, metallurgy, soil engineering, and structures. Students are permitted and encouraged to follow interdisciplinary programs which include more than one area of specialization and may require taking courses in more than one department.

## Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.000) or better in undergraduate

study. Those with lower averages may be admitted upon recommendation of the department, providing they satisfy the minimum requirements of the Graduate College. Practicing engineers who wish to return to school for graduate instruction may be admitted on a limited status if their professional experience makes it appear likely that they will be able to follow the program successfully. This limited admission will become permanent after the completion of at least 16 quarter hours with an average of 4.000 or better.

## Degree Requirements

A grade-point average of at least 4.000 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

### Master of Science

Forty-eight quarter hours are required; of these at least 16 must be in courses at the 400 level. Because of the diversity of the department offerings and areas of concentration the department does not prescribe any specific courses. However, to insure adequate breadth, the following distribution is required:

At least two courses in mathematics.

At least two courses (other than those in mathematics) outside the student's area of specialization. It may often be desirable to take these two courses outside the Department of Materials Engineering.

The satisfaction of these distribution requirements is subject to departmental verification.

The student may, at his discretion\* and in consultation with his adviser, elect to take up to 12 hours of Materials Engineering 499, Thesis Research. In order to obtain credit he has the following options:

- A. For 1 to 4 hours of credit—a report on his work, to be evaluated by his adviser.
- B. For 5 to 8 hours of credit—a report on his work, to be evaluated by a department committee.
- C. For 9 to 12 hours of credit—a thesis based on original work.

### Doctor of Philosophy

To become a candidate for the doctorate a student must pass a departmental qualifying examination. This examination may be waived if the student has attained a graduate grade-point average of 4.500 or better.

Approximately 48 quarter hours of course work beyond the M.S. (or the equivalent) are required. There are no specific course requirements. However,

\*In the metallurgy area of concentration a thesis (option C) is required.

at least two courses must be taken in the Department of Energy Engineering. Interdisciplinary and interdepartmental programs involving other departments, especially the Department of Energy Engineering, are also encouraged. Toward the end of his course work the student is required to pass a preliminary examination administered by a faculty committee.

A major requirement of the Ph.D. program is the completion of a thesis based on a program of original research, which is carried out and written under the supervision of a faculty committee of at least five members. The thesis must be defended before the committee and the public in an examination, notice of which appears in an official campus publication.

The number of credit hours required for the doctoral thesis is not fixed and is adjustable in accordance with the regulations of the Graduate College. Although formal thesis research often does not start until completion of the preliminary examination requirements, it is also common to initiate an informal research program while the student is still involved in course work.

Reading proficiency in one foreign language is required. The language must be French, German, or Russian unless the student is able to demonstrate to the department that a sufficient body of literature in his field of study exists in a substitute language. The language requirement is satisfied by passing the E.T.S. foreign language examination or by completing language courses with a grade of at least B, or by translating a technical paper selected by the department.

## Courses for Graduate and Advanced Undergraduate Students

302. **Applied Elasticity I. 4 hours.** Variational theorems of elasticity theory. Application to establishment and solution of approximate systems; beams (including shear deformations) and plates. Introduction to instability theory. Prerequisite: MatE. 205 or 206.
303. **Theory of Elasticity I. 4 hours.** The boundary value problems of linear isotropic elasticity theory. Uniqueness of solution. Reduction to two dimensions: the plane problem, torsion, bending. General orthogonal coordinates and special application to polar coordinates. Three-dimensional problems with axial symmetry. Prerequisite: MatE. 316.
304. **Experimental Stress Analysis. 4 hours.** Structural similitude and dimensional analysis. Brittle coating. Introduction to photoelasticity. Strain measurement techniques. Prerequisite: MatE. 206.
308. **Intermediate Vibration Theory. 4 hours.** Analytical and numerical treatment of vibrations induced in  $n$ -degrees of freedom linear discrete systems by periodic, shock, and random excitation. Prerequisite: MatE. 208.
311. **Intermediate Dynamics. 4 hours.** Kinematics of a point; space curves. Particle dynamics, orbital motion, and stability. Moving reference frames. Rigid body



dynamics: the inertia tensor, Euler's equations, application to gyroscopic motion. Hamilton's principle. Generalized coordinates. Lagrange's equations. Prerequisites: MatE. 102 and Math. 220.

312. **Nonlinear Oscillations.** 4 hours. Exact and approximate methods of studying vibrations of nonlinear systems. Analytical and graphical techniques. Forced oscillations, self-excited systems, stability criteria. Computer methods. Practical applications. Prerequisite: MatE. 208.
313. **Applied Dynamics.** 4 hours. Application of principles of dynamics to engineering physics. Balancing; rolling and sliding contact, static and dynamic force analyses of machine elements. Critical speeds. Impact loading. Prerequisite: MatE. 311.
316. **Introduction to Continuum Mechanics.** 4 hours. Same as Energy Engineering 316. Cartesian tensors, kinematics of fluids and solids, conservation equations, constitutive equations for simple materials. Examples. Prerequisites: EnrE. 211 or MatE. 204; Math. 220.
321. **Structural Analysis II.** 4 hours. Establishment of basic equations governing linear structural systems. Matrix inversion and relaxation solutions. Approximate analyses. Introduction to dynamics of structures. Prerequisite: MatE. 207.
322. **Concrete Technology I.** 4 hours. Relations between microproperties and macroproperties; mechanisms of fracture, creep, and shrinkage; statistical aspects; air entrainment; special types of concrete. Individual research project involving laboratory and analytic techniques. 3 hours, lecture; 2 hours, laboratory. Prerequisite: MatE. 203 or the equivalent.
324. **Limit Analysis and Design of Structures.** 4 hours. Boundedness principles of perfect plasticity. Application to analysis and design of structures. Prerequisite: MatE. 207.
325. **Concrete Design of Shell and Plate Structures.** 4 hours. Derivation of membrane and bending theories for shells of revolution, folded plates, and shell of single and double curvature. Application to barrel roofs, domes, and storage tanks. Prerequisites: Math. 220 and MatE. 225 or 302.
326. **Design in Prestressed and Precast Concrete.** 4 hours. Behavior and design of prestressed and precast concrete structures. Prestressing systems; problems of shrinkage, creep, and anchorage. Design of beams, slabs, containment vessels, and piles. Design of precast concrete building systems. Prerequisite: MatE. 225.
331. **Electron Theory of Metals.** 3 hours. Modern physical concepts of metals and alloys. Introduction to wave mechanics. Thermal, electrical, and magnetic properties of metals. Band theory of metals. Prerequisite: MatE. 252.
332. **Advanced Diffraction Analysis.** 3 hours. Single crystal methods in X-ray diffraction, orientation determination, pole figures, structure determination, precision lattice constant methods. Prerequisite: MatE. 239 or the equivalent.



333. **Design Use of Materials. 4 hours.** Extreme value statistics, mechanical effects of a notch. Fracture mechanics. Fatigue. Stress rupture. Residual stress effects. Relationships of designed performance. Prerequisite: MatE. 230.
334. **Metallurgy of Nuclear Materials. 3 hours.** Uses of materials for the production of nuclear energy, environmental problems associated with radiation damage, mechanical and physical property changes, swelling, poisoning, fission, moderation, neutron capture, and latent activity. Prerequisites: MatE. 252 and Phys. 114.
335. **Electron Microscopy. 3 hours.** The electron microscope and its application to the study of surface replicas and thin films of metals, alloys, and other materials. Sources of contrast. Selected area diffraction. Prerequisites: MatE. 239 and 252.
337. **Process Metallurgy of Iron and Steelmaking. 4 hours.** Physicochemical principles applied to reduction, conversion, and refining of steel and ferrous alloys. Applications of thermodynamics to equilibrium problems, such as slag-metal equilibria, and applications of process engineering principles to the dynamic behavior of various component systems, such as sinter plants, blast furnaces, and basic oxygen furnaces. Prerequisite: MatE. 243.
338. **Particulate Solids Processing. 4 hours.** Characterization of particulate solids by size and shape. Size classification and reduction processes. Wet and dry separation processes. Transportation and agglomeration of particulate solids. Fluidized beds and fluidization. Prerequisite: EnrE. 234 or MatE. 248.
341. **Theoretical Soil Mechanics I. 3 hours.** Theories used in soil mechanics. Derivation of theoretical relationships and theoretical implications of empirical laws. Theories of deformation of soil systems; states of stress and deformation in soil masses; one-dimensional theory of consolidation for homogeneous and nonhomogeneous clay layers; seepage as a function of isotropy and homogeneity. Prerequisite: MatE. 260.
342. **Theoretical Soil Mechanics II. 4 hours.** Stresses and displacements in earth masses. The analysis of layered systems: analytical, finite difference, finite element methods. Settlement analysis: soil-structure interaction. Analysis of structural response of flexible and rigid pavements. Development of problem-oriented computer languages for settlements. Prerequisites: MatE. 341 and Math. 322.
343. **Theoretical Soil Mechanics III. 4 hours.** Seepage through earth masses; derivation of basic equations; analytical and numerical methods of solution; rapid drawdown. Stability of earth slopes; derivation of basic relationships; methods of Fellenius, Bishop, Morganstern. Computer methods for slope stability and seepage; problem-oriented languages. Prerequisite: Math. 322.
344. **Physical-Chemical Principles of Soil Behavior I. 4 hours.** Clay mineralogy, soil formation and composition, sedimentation, mineral identification, colloidal phenomena in soils. Prerequisite: MatE. 260.
345. **Physical-Chemical Principles of Soil Behavior II. 4 hours.** Swelling, ion association, soil-water analysis of mechanical behavior of soils in terms of physiochemical principles, and conduction phenomena. Prerequisite: MatE. 344.

346. **Physical-Chemical Principles of Soil Behavior III.** 4 hours. Deformation mechanisms and strength, compaction, frost action, rate processes, such as secondary compression, creep, thixotropy. Prerequisite: MatE. 345.
360. **Deformation Processing.** 4 hours. Principles of deformation processes. Basic methods of problem solving. Practices and process control. Relations between processing and finished properties. Prerequisite: MatE. 230.
361. **Deformation Processing Laboratory.** 1 hour. Measurement of flow stress and formability. Effect of friction in forging, rolling, and deep drawing. Limiting reductions, optimum die angles in drawing. Effect of plastic anisotropy in deep drawing. Prerequisite: MatE. 360.
362. **Powder Metallurgy.** 3 hours. Physical attributes of fine powders. Mechanics of pressing. Theories of solid state sintering. Liquid phase sintering. Manufacturing aspects. Prerequisite: MatE. 230.
363. **Advanced Phase Diagrams.** 3 hours. Ternary phase equilibria in metal systems. Vertical and horizontal sections, methods of construction and interpretation. Examination of quaternary and more complex systems. Application of thermodynamic principles to construction. Prerequisite: MatE. 250.
384. **Design in Material Processes.** 3 hours. Design and optimization of chemical and mechanical metallurgical processing systems. Process modeling and analysis. Direct search linear and dynamic programming solutions of process problems. Economic analysis and investment strategy. Prerequisite: MatE. 243 or 244, or EnrE. 234.
391. **Seminar.** 1 hour. Topics to be arranged. Prerequisite: Consent of the instructor.
393. **Special Problems.** 2 to 4 hours. Special problems or reading by special arrangement with the faculty. Prerequisite: Consent of the instructor.

## Courses for Graduate Students

402. **Applied Elasticity II.** 4 hours. Development of classical plate equation and boundary conditions; solution of problems in rectangular and polar coordinates; energy principles; plates with variable thickness; large deflection theory; effect of shear deformations. Prerequisite: MatE. 302.
403. **Theory of Elasticity II.** 4 hours. Review of complex variable theory, application to torsion, bending, and plane problem. The general three-dimensional problem, stress functions, singularities. Introduction to elastokinetics. Prerequisite: MatE. 303.
404. **Plasticity I.** 4 hours. Basic postulates of plasticity. Yield conditions and associated flow laws. Torsion of cylindrical and prismatic bars. Generalized stresses and strain rates. Theorem of limit analysis. Application of limit analysis to plane problems, plates, and shells. Prerequisite: MatE. 316.

406. **Theory of Shells.** 4 hours. Differential geometry; geometry of deformation; equations of equilibrium; energy theories; membrane theory; general bending theory. Application to shells of different geometry. Prerequisites: MatE. 302 and Math. 322.
408. **Theory of Viscoelasticity.** 4 hours. Establishment of the field equations of viscoelastic materials and mathematical techniques of solving these equations. Prerequisites: MatE. 303 and Math. 322.
411. **Vibrations of Structural Elements.** 4 hours. Analytic and numerical treatment of vibrations in elastic strings, beams, plates, etc. Prerequisite: MatE. 308.
412. **Wave Propagation in Solids I.** 4 hours. Stress wave propagation in solids; emphasis on waves involving one space variable in linear and nonlinear materials. Analytical and experimental techniques. Laboratory demonstrations. Prerequisites: MatE. 302 and Math. 322.
413. **Wave Propagation in Solids II.** 4 hours. Wave propagation in solids which involve more than one space variable. Waves in a half-space due to a pulse on the surface or inside the half-space. Waves in cylindrical rods, beams, and plates. Scattering problems. Wave front analysis by geometrical optics. Prerequisites: MatE. 412.
419. **Nonlinear Continuum Mechanics I.** 4 hours. Same as Energy Engineering 419. Kinematics and fundamental laws of mechanics. General constitutive equations; reduced constitutive equations. Homogeneous motions of simple bodies. Isotropic group, simple fluids, simple solids, simple subfluids. Examples. Prerequisite: MatE. 316.
420. **Nonlinear Continuum Mechanics II.** 4 hours. Same as Energy Engineering 420. Special classes of materials. Simple fluids, viscometric flows, the Weissenberg effect. Isotropic elastic materials, exact solutions. Wave propagation. Thermodynamics. Nonlinear viscoelastic materials, polar materials and other materials. Prerequisite: MatE. 419 or EnrE. 419.
421. **Structural Analysis III.** 4 hours. Application of matrix, numerical, and computer techniques to the analysis of complex structural systems. Prerequisite: MatE. 321 or the equivalent.
422. **Mechanics of Reinforced Concrete.** 4 hours. Introduction to composite materials; properties of steel, concrete, and the bond between steel and concrete. Elastic, inelastic, and post-failure behavior of reinforced concrete members. Effects of continuity. Effects of time. Probabilities of uncertainties of materials and loadings. Analysis of design codes. Prerequisite: MatE. 322.
423. **Elastic Instability I.** 4 hours. Principles of elastic instability and their analytical, numerical, and experimental treatment. Buckling of columns, frames, rings. Lateral and torsional instability. Prerequisite: MatE. 302. A knowledge of partial differential equations is required.
424. **Elastic Instability II.** 4 hours. General discussion: small displacements superimposed on finite deformations; application to plates and shells; post-buckling



- analysis; dynamic instability. Prerequisite: MatE. 423. A knowledge of partial differential equations is required.
432. **Dislocation Theory. 4 hours.** Nature of dislocation in crystals. Static and dynamic behavior. Interaction with solute atoms, precipitates, and other dislocations. Effect on mechanical properties. Dislocation interactions, reductions, and dislocation arrays. Prerequisite: MatE. 316.
433. **Advanced Mechanical Metallurgy. 4 hours.** Mechanical flows of metals and alloys from the standpoint of continuum mechanics. Application to basic metal-forming operations. Prerequisite: MatE. 316.
434. **Advanced Experimental Methods. 4 hours.** First of two courses covering the theoretical and operational aspects of advanced materials research methods at an advanced level. Design of complex experimental devices. Applications and limitations. Treatment of data. Prerequisite: MatE. 230.
441. **Mechanics of Multiphase Systems. 4 hours.** Three-dimensional theory of multiphase media including effects of applied forces, thermo-osmosis, electroosmosis, and chemical potentials. Three-dimensional theory of consolidation; derivation, solution by analytical and numerical means. Analysis of three-dimensional consolidation effects. Prerequisites: MatE. 316 and 341.
442. **Strength and Deformation Theories of Soil. 4 hours.** Theories of plasticity as applied to soil mechanics. Problems of limiting equilibrium. Application of plasticity theories to problems of bearing capacity, earth pressure, and slope stability. Mechanics of granular systems. Prerequisites: MatE. 316 and 341. A knowledge of partial differential equations is required.
447. **Advanced Soil Engineering I. 4 hours.** Analysis of displacements of structures due to earth deformation. Site exploration; analysis of foundation types; shallow and deep foundations; settlements; bearing capacity. Retaining structures. Prerequisite: MatE. 261.
461. **Advanced Deformation Processing I. 4 hours.** Fundamental aspects of yielding and ductile failure in important deformation modes. Deformation of crystal aggregates and development of textures. Metallurgical changes during deformation. Effect of plastic flow on basic friction processes. Prerequisite: MatE. 360.
462. **Advanced Deformation Processing II. 4 hours.** Interactions between workpiece and equipment. Dynamic response of system. Design of process around material. Experimental techniques. Prerequisite: MatE. 461.
463. **Fundamentals of Friction, Lubrication, and Wear. 4 hours.** Measurement and theories of friction. Adhesion between similar and dissimilar materials pairs. Mechanisms of wear. Boundary, thin film, hydrodynamic and elastohydrodynamic lubrication. Prerequisite: MatE. 230.
464. **Embrittlement Phenomena. 3 hours.** Physical characteristics of cracking originating from temperature, microstructure, and environment. Theories of the origins of embrittlement. Prerequisite: MatE. 333.



- 465. **Advanced Metallurgical Thermodynamics.** 4 hours. Treatment of multicomponent system thermodynamics with emphasis on metallurgical process applications. Development of relation between structure of metallic solutions, molten salts, and quasi-chemical models. Introduction to the relations between defects in nonmetallic crystals and the gas-phase composition. Prerequisite: EnrE. 305.
- 493. **Special Problems.** 1 to 4 hours. Special topics, seminars, or other special activities.
- 494. **Special Topics in Process Metallurgy.** 0 to 4 hours. May be repeated for a maximum of 12 hours. Selected topics of special interest in the design and analysis of mineral and metal production processes, including transport phenomena, physical chemistry, and design, control, and optimization problems. Prerequisite: MatE. 248 or the equivalent.
- 499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Individual research: reading, design, analytical studies, or laboratory assignments. Culminates in report, master's thesis, or doctoral thesis. Examination on report or thesis is required.

## MATHEMATICS

**Professors:** Joseph Landin, Head of the Department; Harold W. Bailey, Norman Blackburn, Herbert J. Curtis, Flora Dinkines, Philip Dwinger, Irwin K. Feinstein, Paul Fong, Evelyn Frank, Victor K.A.M. Gugenheim, Norman Hamilton, Noboru Ito, Shmuel Kantorovitz, Marvin Knopp, Louis L. Pennisi, Reuben I. Sandler, W. Forest Stinespring, Victor Twersky

**Associate Professors:** Furio Alberti, Warren H. Brothers, Djairo G. DeFigueiredo, David A. Foulser, Louis I. Gordon, Brayton I. Gray, Richard Handelsman, Louise Hay, Christoph H. Hering, William A. Howard, William H. Kantor, James Kelleher, Richard G. Larson, James W. Moeller, Pramod K. Pathak, G.V. Ramanathan, Neil W. Rickert, Robert I. Soare, Alexander P. Stone, Avrum I. Weinzwieg, Alexander Zabrodsky

**Assistant Professors:** Ruth M. Ballard, Neil E. Berger, Bernard Berlowitz, Joel Berman, James A. Donaldson, Verena H. Dyson, Helmut Epp, Samuel Feder, Gerald L. Gordon, Robert Grannick, Floyd Hanson, Morton E. Harris, Melvin L. Heard, Steven L. Jordan, Louis H. Kauffman, Sim Lasher, Jeff E. Lewis, Mu-chou Liu, Robert P. Martineau (Visiting), Arthur Pu, Lena Pu, T.E.S. Raghavan, Martin Tangora, Glenn Weller, Leo F. Ziomek

**Instructors:** Steven L. Jordan

The department offers graduate work leading to the Master of Arts and the Master of Science, the Master of Science in the Teaching of Mathematics, and the Doctor of Philosophy.

## Admission Requirements

Applicants must have a grade-point average of 3.750. The average is computed from the last 90 quarter hours of work completed, including undergraduate and graduate courses. Students with averages below 3.750 but above 3.500 are considered on an individual basis. An applicant must also have a 4.000 average in all mathematics courses beyond calculus.

Students should have 30 quarter hours of undergraduate work in mathematics in addition to the usual beginning courses in algebra, trigonometry, analytic geometry, and calculus. For the master's degree in mathematics these 30 hours must include one year of work in analysis (equivalent to Mathematics 310, 311, 312) and one year of work in an introduction to higher algebra (equivalent to Mathematics 340, 341, 342). The remaining hours should be in mathematics courses at the 300 level (or their equivalents.) Degree requirements are stated below.

Applicants are required to take the Graduate Record Examination (Verbal, Quantitative, and Advanced) and to submit three letters of recommendation from persons familiar with their academic work. If a candidate is admitted with deficiencies in courses normally required for admission, he must remove such deficiencies during the first three quarters of his attendance. No graduate credit is given for such courses. A student who has done graduate work at a recognized institution may petition to receive credit for such work.

## Degree Requirements

### Master of Arts and Master of Science in Mathematics

Forty-eight quarter hours are required for the degree. Of these at least 36 must be in mathematics; at least 20 of the 36 hours must be in approved 400-level courses. The candidate must pass a written examination, details about which may be obtained from the department coordinator of graduate studies. A thesis is not required.

### Master of Science in the Teaching of Mathematics

The purpose of this program is to strengthen the preparation of present and future secondary school teachers of mathematics and, in particular, to provide courses leading to certification in the State of Illinois for those candidates who are not already certified.

The course requirements provide for the admission of students of varying undergraduate backgrounds and include a number of courses required in the undergraduate curriculum in teacher education in mathematics. Therefore,

the requirements may be met either by work completed in the student's undergraduate program or by work done in his graduate program, but the graduate program must include 48 quarter hours of graduate credit.

Applicants must meet the required grade-point average stated in the general admission requirements and must have completed 30 quarter hours of undergraduate mathematics in courses beyond the calculus.

A candidate must earn 48 quarter hours of graduate credit, of which 24 hours must be in mathematics, 12 hours in psychology or education, and 12 hours in electives. At the conclusion of this program the student must have completed, either as part of the required 48 hours or as part of his undergraduate program, the following:

1. Mathematics 310 and at least 4 quarter hours of analysis beyond Mathematics 310.
2. Mathematics 340, 341, and at least 4 quarter hours of algebra beyond Mathematics 341.
3. Mathematics 303, 304, 305, and at least 4 quarter hours of geometry beyond Mathematics 305.
4. At least 4 quarter hours in a course concerned with the problems of teaching secondary school mathematics.
5. At least 12 quarter hours of graduate credit in mathematics to be chosen, with the approval of his adviser, from logic, finite differences, number theory, history of mathematics, topology, computer science, probability and statistics, or other fields.

In addition, he must be eligible for a certificate to teach mathematics at the secondary level in the State of Illinois. This requirement may be waived for candidates with teaching experience.

The psychology or education courses and the electives must be chosen with the approval of the adviser. In general, the electives will be courses in mathematics, psychology, or education. In exceptional cases courses in other fields may be used as electives. Courses at the 400 level are not required for the degree.

Candidates whose undergraduate work is comparable to that required at Chicago Circle for a Bachelor of Science in the Teaching of Mathematics can fulfill the requirements in one year. A candidate who has not completed comparable work in analysis, algebra, and geometry cannot expect to qualify for the degree in one year and will need more than 48 hours of course work to fulfill the requirements.

For further details concerning certification and any other requirements, candidates should consult the program advisers, Professors Irwin K. Feinstein and Alice Hart.

## Doctor of Philosophy

Each candidate for the doctorate must pass the master's examination. A candidate who has not passed this examination within one year of his



admission will be dropped from the program. In exceptional circumstances the department may extend this time limit.

The student will choose a major subject from the following: algebra, analysis, applied mathematics, geometry, logic, probability and statistics, or topology. He must also choose two internal minors from the preceding list or one internal minor and one outside minor or a full outside minor. The choice of an outside minor must have the approval of the Department of Mathematics. The requirements for such a minor should be checked with the department concerned. The student will present at least 60 quarter hours in 400-level mathematics courses, unless he has chosen a full outside minor that requires 48 hours. At least three 400-level courses are required for each internal minor. Courses must have the approval of the department. Each student is required to have 144 hours of graduate credit, of which 48 hours will usually be thesis credit.

Shortly before the completion of 96 hours of graduate course work the student should select an adviser to direct a thesis in his major area of interest. As soon as possible thereafter, the student must take a preliminary examination. The purpose of this examination is to determine if the student is prepared to undertake a doctoral research program. The exact point in the student's career at which the preliminary examination must be taken is not rigidly fixed, but the department will normally drop a student who has not passed the preliminary examination within one year of completion of the 96 hours of course work. In exceptional circumstances the department may extend this time limit. Further details regarding the examination may be obtained from the graduate coordinator of the department.

The student must demonstrate reading proficiency in any two of the following languages: French, German, or Russian.

Since the purpose of the doctoral program is to provide training in mathematical research and scholarship, the crucial effort is the production of a thesis; therefore, under the guidance of the department the student will write a thesis that is a significant piece of mathematical research acceptable to the department.

## Courses for Graduate and Advanced Undergraduate Students

300. **Teachers Course I. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Important mathematical concepts and the problems involved in the teaching thereof; treatment of numeration systems, set relations, functions, whole numbers, logic, and proof; examination of some of the major new curricula. Prerequisite: Math. 133.
301. **Teachers Course II. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Continues Mathematics 300. Topics, discussed from an advanced viewpoint, include mathematical induction, the completeness axiom, composition



of functions, sequences, a vector approach to geometry, axioms of the Hilbert type. Prerequisite: Math. 300.

302. **Teachers Course III. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Continues Mathematics 301. Topics, discussed from an advanced viewpoint, include arithmetic and geometric progressions, continued sums and products, difference sequences, pigeon-hole principle, limits, continuity, exponential functions, logarithmic functions, circular functions, combinations and permutations. Prerequisite: Math. 301.
303. **Advanced Euclidean Geometry I. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Geometry from Euclid to the present, equivalents of Euclid's fifth postulate, noneuclidean geometries, finite and projective geometries, invariants of configurations under transformation. Prerequisite: Math. 133.
304. **Advanced Euclidean Geometry II. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. The parallel postulate, similarity, area, perpendicularity, circles and spheres, constructions with ruler and compass. Prerequisite: Math. 303.
305. **Advanced Euclidean Geometry III. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Ruler and compass constructions, proportionality, length and area, solid mensuration, hyperbolic geometry. Prerequisite: Math. 304.
307. **Theory of Sets and the Real Number System. 5 hours.** The elementary set theory and the development of the integers, the rational numbers, and the real numbers. Prerequisite: Math. 133.
309. **Topics in the Teaching of Secondary School Mathematics. 4 hours.** May be repeated for credit. No more than 8 hours may be used toward the Master of Science in the Teaching of Mathematics. Seminars, conferences, or sections on special topics and advanced problems for students majoring in mathematics education and for in-service teachers who wish to study new-curriculum development and special problems in teaching secondary school mathematics. Prerequisite: Math. 302.
310. **Advanced Calculus I. 4 hours.** Differential and integral calculus of vector fields, vector functions, partial differentiation, transformations, improper integrals, double and triple integrals, and applications. Prerequisite: Math. 133.
311. **Advanced Calculus II. 4 hours.** Line and surface integrals, Green's theorem, Stokes' theorem, sequences, infinite series, uniform convergence. Prerequisite: Math. 310.
312. **Advanced Calculus III. 4 hours.** A set of advanced topics selected for applications in the physical sciences and in engineering. Prerequisite: Math. 311.

321. **Elementary Differential Equations II. 4 hours.** Systems of linear first order equations. Boundary value problems for second order linear equations, introduction to partial differential equations. Nonlinear problems described by one or two differential equations of first order. Prerequisite: Math. 220.
322. **Elementary Partial Differential Equations I. 4 hours.** Second order linear partial differential equations and their initial value and boundary value problems. Separations of variables and Green's formula considerations. Eigenfunction expansions for homogeneous and inhomogeneous heat equation in finite domains. Sturm-Liouville problem. Fourier series. Prerequisites: Math. 310 and 321.
323. **Elementary Partial Differential Equations II. 4 hours.** The potential equation and the wave equation in finite domains. Semi-infinite domains. Fourier integrals. Cylindrical and spherical harmonics. Fourier-Bessel and Legendre-Bessel expansions. Prerequisite: Math. 322.
330. **Complex Analysis for Applications I. 4 hours.** Credit is not given for both Mathematics 330 and 332. Complex numbers and their geometrical representation, analytic functions, elementary functions, complex integration, Taylor and Laurent series, the calculus of residues, introduction to conformal mapping. Prerequisite: Math. 310.
331. **Complex Analysis for Applications II. 4 hours.** Branch-point integration, series and product expansions, complex integral representations of special functions (gamma, hypergeometric, Legendre, Bessel), asymptotic methods, introduction to transforms. Prerequisites: Math. 321 and 330.
332. **Complex Variables I. 4 hours.** Credit is not given for both Mathematics 332 and 330. Power series in one variable, holomorphic functions, Cauchy's integral theorem, Taylor and Laurent expansions. Prerequisite: Math. 312.
333. **Complex Variables II. 4 hours.** Analytic functions of several complex variables, harmonic functions, convergence of sequences of holomorphic functions, infinite products, normal families, holomorphic transformations, holomorphic systems of differential equations. Prerequisite: Math. 332.
340. **Modern Higher Algebra I. 4 hours.** Sets and real numbers, groups, rings. Prerequisite: Math. 133.
341. **Modern Higher Algebra II. 4 hours.** Euclidean and polynomial rings, vector spaces, linear transformations, and matrices. Prerequisite: Math. 340.
342. **Modern Higher Algebra III. 4 hours.** Dual spaces, inner-product spaces, modules, canonical forms of matrices, quadratic forms. Prerequisite: Math. 341.
343. **Formal Logic I. 4 hours.** Same as Philosophy 343. Propositional logic, logic of quantifiers, and identity and completeness. Prerequisite: Consent of the instructor; none for mathematics majors.

344. **Formal Logic II. 4 hours.** Same as Philosophy 344. Continues Mathematics 343. Mathematical analysis of decidability and computability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Prerequisite: Math. 343.
348. **Linear Transformations and Matrices. 5 hours.** Matrix algebra, determinants, inverses of matrices, rank and equivalence, linear independence, vector spaces and linear transformation, unitary and orthogonal transformations, characteristic equation of a matrix. Prerequisite: Math. 133.
350. **Introduction to Higher Geometry I. 4 hours.** Projective properties in the euclidean plane, extending the euclidean plane, the projective plane, axioms for the projective plane, conics, introduction of coordinates. Prerequisite: Math. 342.
351. **Introduction to Higher Geometry II. 4 hours.** Topics in geometry, projective planes, higher dimensional projective geometries, model as subspaces of a vector space, coordinatization. Prerequisite: Math. 350.
353. **Introduction to Differential Geometry. 4 hours.** Curves, surfaces, manifolds imbedded in euclidean space, Riemannian geometry, first and second fundamental forms of imbedded surfaces. Prerequisite: Math. 312.
355. **Introduction to Topology I. 4 hours.** Set theory, topological spaces, metric spaces, continuous maps, connectedness, compactness, separation axioms, completely separable spaces, mappings into Hilbert spaces. Prerequisite: Math. 310.
356. **Introduction to Topology II. 4 hours.** Locally connected spaces, arcs and arcwise connectivity, Cantor sets, Hahn-Mazurkiewicz theorem, elements of homotopy theory. Prerequisites: Math. 340 and 355.
357. **Introduction to Topology III. 4 hours.** Vector spaces, polytopes, homology theory, Euler-Poincare formula, simplicial mappings, Brouwer degree and Brouwer fixed-point theorem. Prerequisite: Math. 356.
360. **Elementary Theory of Numbers I. 4 hours.** The basic concepts of the theory of numbers: divisibility, prime numbers congruences, quadratic reciprocity law. Prerequisite: Math. 133 or approval of the department.
361. **Theory of Numbers II. 4 hours.** Functions of number theory, recurrence functions, diophantine equations, quadratic forms, Farey sequences and rational approximations. Prerequisite: Math. 360.
362. **Theory of Numbers III. 4 hours.** Continued fractions, distribution of primes, algebraic numbers, polynomials, partitions, density of sequences of integers. Prerequisite: Math. 361.
370. **Introduction to Probability and Statistics. 4 hours.** Probability models, univariate and multivariate distributions, random variables. Prerequisite: Math. 133.



371. **Statistics I. 4 hours.** Statistical problems and procedures, estimation, testing hypotheses, distribution theory. Prerequisite: Math. 370.
372. **Statistics II. 4 hours.** One-sample problems, comparison, linear models, and analysis of variance. Prerequisite: Math. 371.
375. **Probability. 4 hours.** Law of large numbers, central limit theorem, recurrent events, random walks, Markov chains. Prerequisite: Math. 370.
377. **Finite Differences I. 4 hours.** Difference formulas, finite integration, summation of series, Bernoulli and Euler polynomials, interpolation. Prerequisite: Math. 112 or 133.
378. **Finite Differences II. 4 hours.** Approximate integration, beta and gamma functions, difference equations. Prerequisite: Math. 377.
381. **Vector and Tensor Analysis I. 4 hours.** Algebra of vectors, vector differential calculus, differential geometry, Stokes' theorem, divergence theorem, applications to electricity, mechanics, hydrodynamics, and elasticity. Prerequisite: Math. 311.
382. **Vector and Tensor Analysis II. 4 hours.** Transformation properties, covariant and contravariant tensors, differential geometry of curves and surfaces, exterior differential calculus with emphasis on aspects of interest in science and engineering. Prerequisite: Math. 381.
385. **Laplace Transforms. 3 hours.** The Laplace transform and its inverse; properties of the transform; linear differential equations (ordinary and partial); linear difference equations, gamma, error, and Bessel functions; asymptotic series; nonelementary integrals; integral equations, Hankel transforms. Prerequisite: Math. 330.
387. **Numerical Analysis I. 4 hours.** Mathematics 387 and 388 together provide a comprehensive introduction to linear numerical analysis. Computational methods and error analysis for matrix inversion, eigenvalues and eigenvectors, and linear approximations. Prerequisites: Math. 133; Math. 194 or 195.
388. **Numerical Analysis II. 4 hours.** Continues Mathematics 387. Prerequisite: Math. 387.
389. **Numerical Analysis III. 4 hours.** Numerical integration and differentiation. Quadrature in  $n$  dimensions. Numerical integration of ordinary differential equations. Prerequisite: Math. 388.
391. **Boolean Algebra and Switching Theory. 4 hours.** Sets, relations, functions, equivalence relations, abstract Boolean algebra. Applications of Boolean algebra. Minimization of Boolean functions. Representation of finite Boolean algebras. Prerequisite: Math. 310 or 340.
392. **Introduction to Automata Theory. 4 hours.** Boolean rings and lattices as Boolean algebras. Synchronous sequential circuits. Mealy and Moore models of automata. Regular sets. Prerequisite: Math. 391.



393. **Automata and Languages.** 4 hours. Types of automata and their events. The semigroup of an automaton. Basic decomposition theory. Introduction to formal languages. Grammars of types 0, 1, 2, 3. Properties of context-free languages. Prerequisite: Math. 392.
394. **Simulation Languages.** 4 hours. Digital simulation of complex systems; general purpose and special simulation languages and their useful properties, their design and implementation; a comparison and evaluation of special languages, such as GPSS II, SIMPScript, GASP, SIMPAC, DYNAMO, and SIMULATE: application of at least one of them in a term project. Prerequisites: Math. 280 and 281 or the equivalents.
395. **List-Processing Languages.** 4 hours. List and string-processing languages, such as IPLV, SLIP, COMIT, SNOBOL, and LISP, from the user's point of view. Applications to nonnumeric problems, such as symbolic formula manipulation, information retrieval, and pattern recognition. Prerequisites: Math. 280 and 281 or the equivalents.
396. **Design of Compilers.** 4 hours. Design and implementation of algebraic compilers for a modern digital computer. Prerequisite: Math. 281.
397. **Computer Operating Systems.** 4 hours. Problems of planning and implementing an operating system for a modern digital computer so as to utilize its power to the fullest possible extent. Prerequisite: Math. 281.
398. **Special Topics in Mathematics.** 1 to 4 hours. May be repeated for credit. Course content will be announced prior to each quarter in which it is given. Prerequisite: Consent of the instructor.
399. **Honors in Mathematics.** 4 hours. May be repeated for credit. Seminars on special topics and advanced problems to permit students majoring in mathematics to do independent study under the guidance of senior members of the staff. Prerequisites: Math. 312 and 342.

## Courses for Graduate Students

401. **Second Course in Abstract Algebra I.** 4 hours. Isomorphism theorems, permutation groups, finite groups, Sylow's theorems, structure of finitely generated Abelian groups, composition series, solvable groups. Prerequisite: Math. 342 or the equivalent.
402. **Second Course in Abstract Algebra II.** 4 hours. Field extensions, finite fields, Galois theory, Wedderburn's theorem. Prerequisite: Math. 401.
403. **Second Course in Abstract Algebra III.** 4 hours. Rings and algebras, structure of algebras, multilinear algebra, tensor products. Prerequisite: Math. 402.
404. **Rings and Modules.** 4 hours. The category of R-modules, projective and injective modules, the Morita theorems, elementary homological algebra, separable algebras, homological dimension. Prerequisite: Math. 403.

405. **Finite Groups.** 4 hours. Transfer theorems,  $p$ -nilpotent groups,  $E\pi$ ,  $C\pi$ ,  $D\pi$  properties, solvable groups, Schur-Zassenhaus theorem, additional topics selected by the instructor. Prerequisite: Math. 403.
406. **Free Groups and Universal Properties.** 4 hours. Universal algebras, words and varieties, free algebras, free groups, subgroups of free groups, free products, free associative algebras, Birkhoff-Witt theorem, free Lie algebras. Prerequisite: Math. 403.
407. **Representation Theory.** 4 hours. Representation theory of finite-dimensional algebras, structure of the regular representation, characters, applications to finite groups, theorems of Frobenius and Burnside, character ring, exceptional characters. Prerequisite: Math. 403.
408. **Homological Algebra I.** 4 hours. Abstract categories and functors, adjoints, additive and Abelian categories, functor categories. Prerequisite: Math. 403.
409. **Homological Algebra II.** 4 hours. Complexes, homology, projectives and injectives, connected sequences of functors, satellites, derived functors, ext, tor, the full embedding theorem. Prerequisite: Math. 408.
410. **Nonassociative Algebras I.** 4 hours. Introduction to nonassociative algebras, alternative algebras, power associative algebras, Jordan algebras. Prerequisite: Math. 403.
411. **Nonassociative Algebras II.** 4 hours. Jordan algebras continued, Lie algebras, general classification theorems. Prerequisite: Math. 410.
419. **Advanced Topics in Algebra.** 4 hours. May be repeated for credit. Special topics in algebra. Prerequisite: Consent of the instructor.
421. **Algebraic Topology I.** 4 hours. The category of topological spaces and functors, homology of complexes, singular homology theory, Eilenberg-Steenrod axioms, C-W complex, cohomology and cup-products, universal coefficient theorem. Kunneth theorem. Prerequisites: Math. 342, and 357 or the equivalent.
422. **Algebraic Topology II.** 4 hours. Homotopy groups, Hurewicz theorem, Whitehead theorem, fiber spaces, Postnikov sections, obstruction theory, Serre spectral sequence,  $e$ -theory, applications. Prerequisite: Math. 421.
423. **Algebraic Topology III.** 4 hours. Freudenthal suspension theorem, stable homotopy theory, cohomology operations, construction and cohomology of Eilenberg-MacLane spaces, structure of the Steenrod algebra, Adams spectral sequence. Prerequisite: Math. 422.
429. **Advanced Topics in Topology.** 4 hours. May be repeated for credit. Special topics in topology. Prerequisite: Consent of the instructor.
430. **Real Analysis I.** 4 hours. Set theory, well-ordering cardinal and ordinal numbers, metric spaces, connectedness, compactness, completeness. Prerequisite: Math. 312.

431. **Real Analysis II. 4 hours.** Riemann-Stieltjes integral and its extension, measures and measurable sets, measurable functions, the Lebesgue integral. Prerequisite: Math. 430.
432. **Real Analysis III. 4 hours.** Function spaces, differentiable and nondifferentiable functions, absolutely continuous functions. Prerequisite: Math. 431.
433. **Integral Equations. 4 hours.** Fredholm and Hilbert-Schmidt theory and applications, symmetric kernels and orthogonal systems of functions, some types of singular and nonlinear integral equations. Prerequisite: Math. 312.
434. **Transform Methods. 4 hours.** Mellin and Hankel transforms, multiple Fourier transforms; applications to conduction of heat in solids, to slowing down of neutrons in matter, and to atomic and nuclear physics. Prerequisites: Math. 312; Math. 331 or 333.
435. **Calculus of Variations. 4 hours.** Introductory problems; geodesics, the brachistochrone, minimal surface of revolution. Isoperimetric problems. Geometrical optics, Fermat's principle. Dynamics of particles. Minimum characterization of the eigenvalue-eigenfunction problem. Ritz's method of approximation. Prerequisite: Math. 312.
436. **Functional Analysis I. 4 hours.** Topological vector spaces, Banach spaces, Hilbert spaces, Hahn-Banach theorem, interior mapping principle, uniform boundedness principle, applications, approximation and closure theorems. Prerequisite: Math. 432.
437. **Functional Analysis II. 4 hours.** Linear operators on a Banach space, the spectrum and resolvent of a linear operator, compact operators, spectral theorem for compact Hermitian operators on a Hilbert space, integral equations, Sturm-Liouville theory. Prerequisite: Math. 436.
438. **Functional Analysis III. 4 hours.** Spectral theorem for normal operators on a Hilbert space, unbounded operators, semigroups of linear operators, ergodic theorems. HP spaces of analytic functions, Beurling's theorem on the shift operator, applications. Prerequisite: Math. 437.
440. **Partial Differential Equations I. 4 hours.** Classification of equations and characteristics. The Cauchy-Kowalewski theorem. The Cauchy problem for hyperbolic systems in the plane and space of higher dimension. Uniqueness theorems for the Cauchy problem. Prerequisites: Math. 323, 331 or 333, and 342 or 348.
441. **Partial Differential Equations II. 4 hours.** Elliptic equations; method of balayage; Dirichlet's principle; fundamental solutions; potential theory; eigenvalue problems. Prerequisite: Math. 440.
442. **Partial Differential Equations III. 4 hours.** Partial differential equations of parabolic type. Distributions and weak solutions of partial differential equations. Elliptic boundary value problems. Prerequisites: Math. 436, 441.

449. **Advanced Topics in Analysis.** 4 hours. May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.
450. **Projective Geometry I.** 4 hours. Coordinatization, collineation groups, Desargues' condition, weakened forms of Desargues' condition and corresponding coordinate systems, fundamental theorem of projective geometry. Prerequisite: Consent of the instructor.
451. **Projective Geometry II.** 4 hours. Finite planes, free planes, collineations of division ring planes and of free planes, the Lenz-Barlotti classification. Prerequisite: Math. 450.
452. **Differential Geometry I.** 4 hours. Manifolds, tensor fields, the tensor algebra, the Grassman algebra, exterior differentiation, mappings, transformations of vector fields and differential forms, affine connections, parallelism, the exponential mappings, covariant differentiation. Prerequisite: Consent of the instructor.
453. **Differential Geometry II.** 4 hours. The Riemannian connection, complete Riemannian manifolds, isometrics, curvature, Lie groups. Prerequisite: Math. 452.
454. **Structure of Differentiable Manifolds I.** 4 hours. Tangent bundle, vector fields, tensors, differentiable mappings, geodesics, exponential mapping, Whitney embedding theorem, Morse theory. Prerequisites: Credit or registration in Math. 421 and 430.
455. **Structure of Differentiable Manifolds II.** 4 hours. De Rham theorem, duality, vector bundles, characteristic classes, Hirzebruch index theorem, almost complete structures, Milnor spheres. Prerequisite: Math. 454.
456. **Structure of Differentiable Manifolds III.** 4 hours. Poincare conjecture, structures on manifolds, cobordism theorem, embeddings and immersions, Atiyah-Singer index theorem, Lie groups and Lie algebras, Bott periodicity theorem. Prerequisite: Math. 455.
459. **Advanced Topics in Geometry.** 4 hours. May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.
460. **Recursion Theory I.** 4 hours. Same as Philosophy 460. Introduction to the theory of recursive functions, Turing machines, and effective computability. Godel's incompleteness theorem. Prerequisite: Math. 344.
461. **Recursion Theory II.** 4 hours. Same as Philosophy 461. Classification of recursively enumerable sets, Post's problem, degrees of unsolvability, the arithmetical hierarchy. Prerequisite: Math. 460.
462. **Metamathematics I.** 4 hours. Same as Philosophy 462. Classical first order logic, axiomatic theories, model theory. Prerequisite: Math. 344.
463. **Metamathematics II.** 4 hours. Same as Philosophy 463. Incompleteness, undecidability, nondefinability. Prerequisite: Math. 462.



464. **Metamathematics III.** 4 hours. Same as Philosophy 464. Higher order logic, infinitary logic, proof theory. Prerequisite: Math. 463.
465. **Advanced Set Theory I.** 4 hours. Same as Philosophy 465. Axiomatic set theory, consistency of the continuum hypothesis, and the axiom of choice. Prerequisite: Consent of the instructor.
466. **Advanced Set Theory II.** 4 hours. Same as Philosophy 466. Strong infinity axioms. Independence of the continuum hypothesis and the axiom of choice from Zermelo-Fraenkel's axioms. Prerequisite: Math. 465.
469. **Advanced Topics in Mathematical Logic.** 4 hours. May be repeated for credit. Same as Philosophy 469. Special topics. Prerequisite: Math. 344.
470. **Probability Theory I.** 4 hours. Measure-theoretic aspects of probability theory, characteristic functions, the inversion theorem, the Levy-Cramer continuity theorem, Bochner's theorem, Cramer's theorem and the Herglotz lemma, types of convergence, the Borel-Cantelli lemma, the zero-one law, the law of large numbers, central limit theorems of Lindeberg, Liapunov, and Lindeberg-Feller. Prerequisite: Math. 432.
471. **Probability Theory II.** 4 hours. The central limit problem, conditional probability, martingales, random walk and recurrent events, Markov processes with discrete and continuous parameters, general introduction to processes with independent increments and orthogonal increments, stationary processes, least square prediction. Prerequisite: Math. 470.
480. **Scattering Theory I.** 4 hours. Solutions of the reduced wave equations for scattering of scalar, vector, and dyadic waves; separable and nonseparable problems. Representations: Green's function integrals, complex integrals, inverse distance series, special function series; approximations; geometrical optics and potential theory; applications. Prerequisites: Math. 323, 331, and Phys. 371.
481. **Scattering Theory II.** 4 hours. Representations, theorems, and approximations for many-body problems. Multiple scattering solutions as functionals of single-body functions: integral equations, algebraic equations, series representations, operational closed forms, asymptotic forms. Two-scatterer problems, arbitrary configurations, and periodic sprays. Prerequisite: Math. 480.
482. **Scattering Theory III.** 4 hours. Statistical scattering problems. Scattering by randomly moving distributions. Models for scattering by rough surfaces, gases, and liquids. Relations between scatterer statistics and signal statistics for low-speed distributions. Relativistic scattering problems. Prerequisite: Math. 481.
484. **Mathematical Techniques of Nuclear Reactor Theory I.** 4 hours. Same as Energy Engineering 484. Introduction to nuclear physics and nuclear reactor physics; flux distributions, critical mass, slowing down kernels and their Fourier transforms, two-group steady state theory in the reflected reactor, buckling iteration method, matrix methods in boundary value and criticality problems in the one-dimensional

- multiregion reactor, series solutions of group diffusion equations in multiregion reactor and in two-dimensional fully reflected reactor, reactor criticality codes. Prerequisites: Math. 312, 323, 341 or 348, and 381, or the equivalents.
485. **Mathematical Techniques of Nuclear Reactor Theory II.** 4 hours. Same as Energy Engineering 485. Variational methods in the criticality problem, theory of control rods in cylindrical reactor, introduction to reactor kinetics, perturbation theory and applications, adjoint flux distributions, inhour equation for multiregion multifuel reactors, xenon poisoning and override problem. Prerequisite: Math. 484.
486. **Mathematical Techniques of Nuclear Reactor Theory III.** 4 hours. Same as Energy Engineering 486. Cylindrical reactor with source, power level determination problem, time-dependent flux distributions in multiregion reactor, one-group model, transient and stable flux distributions in multiregion reactor, two-group model, self-limiting power bursts, analysis of nonlinear feedback problems. Prerequisite: Math. 485.
489. **Advanced Topics in Applied Mathematics.** 4 hours. May be repeated for credit. Special topics in applied mathematics. Prerequisite: Consent of the instructor.
490. **Computer Programming for Students in Behavioral Sciences.** 0 hours. Seven-week introduction to Fortran IV. Examples from statistics, business, and the behavioral sciences. The Computer Center cooperates with departments imposing a language requirement in programming in setting examinations for this course.
491. **Computer Programming for Students in the Physical Sciences.** 0 hours. Seven-week introduction to Fortran IV. Examples from mathematics, engineering, and the natural sciences. The Computer Center cooperates with departments imposing a language requirement in programming in setting examinations for this course.
492. **Numerical Methods in Partial Differential Equations I.** 4 hours. Classification of equations and boundary value problems; finite difference analogues for parabolic, hyperbolic, and elliptic equations; explicit and implicit methods of parabolic and hyperparabolic systems; the method of characteristics for hyperbolic equations; stability of initial value problems; iterative methods (modern and classical) for elliptic equations; discretization and round-off errors. Prerequisites: Math. 323 and 389 or the equivalents.
493. **Numerical Methods in Partial Differential Equations II.** 4 hours. Continues Mathematics 492. Prerequisite: Math. 492.
495. **Approximation Theory.** 4 hours. General approximation theory in normed linear spaces with primary emphasis on functions defined on an interval and periodic function; existence and uniqueness theorems; characterization of Chebyshev approximants; degree of approximation; use of approximations in computing. Prerequisites: Math. 312, and 342 or 348, or the equivalents.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Approval of the department.

## PHILOSOPHY

**Professors:** George T. Dickie, Daniel J. Morris, Brian F. Skyrms, William W. Tait, Irving Thalberg

**Associate Professors:** Sandra L. Bartky, Terence D. Parsons

**Assistant Professors:** Daniel P. Berger, David C. Blumenfeld, Marcia Eaton, John J. Economos, Neal Grossman, Michael Jubien, Richard Kraut, Ralf Meerbote, Kathryn P. Parsons, Paul Teller, Robert Tragesser (Visiting), W. Kent Wilson, Jeffery Zucker (Visiting)

The department offers work leading to the Master of Arts and the Doctor of Philosophy.

### Admission Requirements

Applicants must have a grade-point average of at least 4.000 for the last two years of undergraduate work. Students whose average is below 4.000 but above 3.750 will be considered on an individual basis. An undergraduate major in philosophy is not a requirement for admission.

Applicants should have taken courses in modern formal logic, ethics, history of philosophy, and theory of knowledge or philosophy of science. Students admitted with deficiencies must take one or more of the following courses: Philosophy 301, 302, 304, 306, 321, 330, 332.

### Degree Requirements

#### Master of Arts

A student must choose at least one course in each of the following areas: history of philosophy; the theory of knowledge, including logic, philosophy of science, and the philosophy of language; and the theory of value, including ethics and aesthetics. The department also requires the student to complete a unified program of 48 quarter hours of graduate study under the direction of an adviser.

#### Doctor of Philosophy

A full program consists of 16 hours of course work each quarter or a total of 144 quarter hours for the degree. The student must complete all requirements within seven years after entering the program. A student

carrying a full program will generally be expected to complete the requirements in fewer than five years. Exceptions will be permitted only under conditions of unusual hardship.

Students progress toward the Ph.D. in two stages:

1. During the second year, they must take the comprehensive written examination. This examination consists of four parts: history of philosophy; logic, philosophy of language, and philosophy of science; metaphysics and epistemology; and value theory. Some options are allowed; consult the department on these.
2. After a student has passed the comprehensive examination and has chosen the subject of his dissertation, an appointed doctoral committee will administer a preliminary oral examination to determine whether his research project is feasible and is sufficiently original and serious. The committee may then recommend formal advancement to candidacy for the Ph.D., and a member of the committee will be named to supervise the writing of the dissertation. Upon completion of his dissertation the candidate must defend it in a final oral examination.

In addition to the foregoing, each student must take and pass an examination in elementary logic.

The language requirement for each student will be decided by a departmental committee of graduate faculty. The determination will be based on a consideration of the area in which the student intends to specialize. In no case will proficiency in more than two languages be required. In those areas where the primary sources are in English, a foreign language may not be required.

A detailed statement of the special departmental requirements for graduate students can be obtained from the Department of Philosophy, 1803 University Hall.

## Courses for Graduate and Advanced Undergraduate Students

300. **Philosophy of Space and Time. 4 hours.** Geometry and space, contingent and necessary properties of space and time, the direction and flow of time, effects preceding their causes, Zeno's paradoxes. Prerequisite: Phil. 298.
301. **Plato. 4 hours.** Selected dialogues. Prerequisite: Phil. 298.
302. **Aristotle. 4 hours.** Reading and discussion of some of the basic works. Prerequisite: Phil. 298.
303. **Chinese Philosophy. 4 hours.** Development of the major Chinese philosophies. Prerequisite: Two courses in philosophy.



304. **Seventeenth Century Rationalism.** 4 hours. Selected readings and discussion from the works of Descartes, Spinoza, Leibniz, and others. Prerequisite: Phil. 298.
306. **British Empiricism.** 4 hours. Selected readings from the works of such philosophers as Locke, Berkeley, and Hume. Prerequisite: Phil. 298.
308. **Kant.** 4 hours. Kant's philosophy, with emphasis on the *Critique of Pure Reason*. Prerequisite: Phil. 304 or 306 or 330.
310. **Nineteenth Century and Early Twentieth Century Thought.** 4 hours. May be repeated for credit with the approval of the department. Studies of selections from the writings of Hegel, Schelling, Fichte, Schopenhauer, Marx and Engels, J.S. Mill, Nietzsche, McTaggart, Green, Bradley, Peirce, Perry, and others. Prerequisite: Phil. 298.
311. **Inductive Logic.** 4 hours. Traditional and contemporary problems of induction. Inductive logic and the theory of probability. Prerequisite: Phil. 298.
312. **Recent and Contemporary Philosophy: Analysis and Logical Empiricism.** 4 hours. Developments in recent philosophy which have their roots in the study of logic and language, such as logical atomism, positivism, and analytical philosophy. Prerequisite: Phil. 298.
313. **The Claims of Science and Religion.** 4 hours. Convergence and conflict between the results of science and the claims of religion; similarities and differences between their methods of inquiry. Prerequisites: Phil. 214 and one other course in philosophy.
314. **Recent and Contemporary Philosophy: Phenomenology and Existential Philosophy.** 4 hours. Important contributions to the phenomenological movement. Selected readings from Husserl, Heidegger, Jaspers, Sartre, Merleau-Ponty, and others. Prerequisite: Two courses in philosophy.
321. **Introduction to Formal Logic.** 4 hours. Not open to students with credit or current enrollment in Philosophy 211. Four meetings per week coincide with Philosophy 211 (see Undergraduate Catalog for description of Philosophy 211). One additional meeting per week is devoted to an introduction to elementary set theory plus extra topics related to work in Philosophy 211.
322. **Problems in the Foundations of Logic and Mathematics.** 4 hours. Survey of selected problems. Prerequisite: Phil. 211 or the equivalent.
330. **Theory of Knowledge.** 4 hours. The grounds of belief; the nature of truth; evidence and proof; other related epistemological problems. Prerequisites: Phil. 230 and 298.
332. **Ethics and Value Theory.** 4 hours. The nature of moral judgments and moral reasoning; ethics as a normative discipline; definitions of "value"; ethical judgments as a kind of value judgment. Prerequisite: Two courses in philosophy, one of which must be a 200-level course.

334. **Aesthetics. 4 hours.** The aesthetic object. Form, representation, and meaning in art. Art and knowledge. Prerequisite: Phil. 298.
336. **Topics in Metaphysics. 4 hours.** Systematic analysis of selected metaphysical concepts, such as existence, substance and attribute, universals and particulars, change, identity, space and time, and the individual. Recent and traditional points of view are considered. Prerequisites: Phil. 236 and 298.
338. **Philosophical Analysis of the Concept of Mind. 4 hours.** Presuppositions and logical interconnections involved in the use of such terms as "mind," "thoughts," "action," "intention," and "will." Prerequisite: Phil. 298.
340. **Philosophy of Language. 4 hours.** Philosophical and logical problems concerned with the nature of meaning and the structure of language. Individual conferences on assigned papers are required. Prerequisites: Phil. 211, 240, and 298.
343. **Formal Logic I. 4 hours.** Same as Mathematics 343. Propositional logic, logic of quantifiers, and identity and completeness. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor; none for mathematics majors.
344. **Formal Logic II. 4 hours.** Individual conferences on assigned papers are required. Same as Mathematics 344. Continues Philosophy 343. Mathematical analysis of decidability and computability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Prerequisite: Phil. 343.
345. **Philosophical Problems of the Sciences. 4 hours.** May be repeated for credit with the permission of the department. Reading and discussion of selected works on the aims and methods of science, the status of scientific theories, natural laws and theoretical entities, and the nature of explanation. Prerequisite: Phil. 298.
351. **Problems in the Philosophy of Mathematics. 4 hours.** Intensive study of a particular problem or nexus of problems in the philosophy of mathematics. Prerequisite: Phil. 298.
399. **Independent Study. 1 to 8 hours.** Independent study, under the supervision of a staff member, of a topic not covered in the regular curriculum. The course is offered at the request of the student and only at the discretion of the staff members concerned. Prerequisite: Approval of the department.

## Courses for Graduate Students

401. **Seminar: Topics in Ancient Philosophy. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
403. **Seminar in Medieval Philosophy. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Persistent problems in the philosophy of the Middle Ages.

405. **Seminar: Topics in Modern Philosophy.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive analysis of the work of one important philosopher or philosophical movement between 1600 and 1900.
407. **Seminar: Topics in Contemporary Philosophy.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive analysis of the work of one important philosopher or philosophical movement of the twentieth century.
411. **Seminar in Recent Ethical Theory.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
413. **Seminar in Philosophical Topics in Logic.** 6 hours. May be repeated once for credit with the consent of the instructor. Two sections may be taken concurrently when topics vary.
415. **Seminar in Metaphysics.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
417. **Seminar in the Philosophy of Science.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
419. **Seminar in the Philosophy of Language.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
421. **Seminar in the Theory of Knowledge.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Selected topics in the contemporary theory of knowledge.
423. **Seminar in Aesthetics.** 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.
460. **Recursion Theory I.** 4 hours. Same as Mathematics 460. Introduction to the theory of recursive functions, Turing machines, and effective computability. Godel's incompleteness theorem. Prerequisite: Phil. 344.
461. **Recursion Theory II.** 4 hours. Same as Mathematics 461. Classification of recursively enumerable sets, Post's problem, degrees of unsolvability, the arithmetical hierarchy. Prerequisite: Phil. 460.
462. **Metamathematics I.** 4 hours. Same as Mathematics 462. Classical first order logic, axiomatic theories, model theory. Prerequisite: Phil. 344.
463. **Metamathematics II.** 4 hours. Same as Mathematics 463. Incompleteness, undecidability, nondefinability. Prerequisite: Phil. 462.

464. **Metamathematics III.** 4 hours. Same as Mathematics 464. Higher order logic, infinitary logic, proof theory. Prerequisite: Phil. 463.
465. **Advanced Set Theory I.** 4 hours. Same as Mathematics 465. Axiomatic set theory, consistency of the continuum hypothesis, and the axiom of choice. Prerequisite: Consent of the instructor.
466. **Advanced Set Theory II.** 4 hours. Same as Mathematics 466. Strong infinity axioms. Independence of the continuum hypothesis and the axiom of choice from Zermelo-Fraenkel's axioms. Prerequisite: Phil. 465.
469. **Advanced Topics in Mathematical Logic.** 4 hours. May be repeated for credit. Same as Mathematics 469. Special topics. Prerequisite: Phil. 344.
479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology.** 2 hours. Same as History 479 and Psychology 479. May be repeated. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.
483. **Independent Study.** 2 to 8 hours. Topics and plan of study must be approved by the candidate's adviser and by the staff member who directs the work.
490. **Seminar in the Teaching of Philosophy.** 1 hour. May be repeated for credit. Discussion of problems connected with the teaching of introductory courses in philosophy. Required of all graduate students in philosophy unless excused by the department. All teaching assistants will be required to enroll during the tenure of their assistantships.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit.

## PHYSICS

**Professors:** Swaminatha Sundaram, Head of the Department; Seymour Bernstein, Arnold R. Bodmer, James W. Garland, James S. Kouvel, Edward B. McNeil, R. Curtis Retherford, Herman B. Weissman, Lester Winsberg

**Associate Professors:** Stanley Aks, Richard A. Carhart, Alan S. Edelstein, Howard S. Goldberg, Gloria A. Hoff, Stephen J. Kreiger, Seymour Margulies, William J. Otting, Antonio Pagnamenta, John N. Pappademos, David S. Schreiber, Ram R. Sharma, Julius Solomon, David J. Vezzetti

**Assistant Professors:** Larry L. Abels, Robert J. Abrams, Helmut Claus, Jerome E. Jackson (Visiting), Jack A. Kaeck, Arthur L. Licht, Donald W. McLeod, James G. Ring (Visiting), Josip Z. Soln (Visiting), Norman D. Strahm (Visiting), Ben Varga



The department offers graduate work leading to the Master of Science and the Doctor of Philosophy with the following areas of specialization:

*Atomic and Molecular Physics*—oscillator strengths, vibrational and rotational spectra, high temperature properties, lasers, vacuum UV.

*High Energy Physics*— $K^0$  decays, CP violation, scattering, weak and strong interactions, resonances, symmetries, field theory, Regge poles.

*Nuclear Physics*—nuclear structure, hypernuclei, nuclear potentials, deformed nuclei;

*Solid State Physics*—magnetic resonance and static susceptibility, specific heat, electron tunneling and transport properties of metals, superconductors, and insulators; studies at ultra-low temperatures; optical and dielectric properties.

*Theoretical Physics*—atomic-molecular energies; superconductivity, dispersion relations, lattice properties, electron-phonon interactions, crystal fields, quantum hydrodynamics; nuclear structure and hypernuclei; field theory, particle interactions, resonances and scattering; statistical mechanics.

## Degree Requirements

### Master of Science

Satisfactory completion of 48 quarter hours of course work is required with at least 24 hours in physics, including Physics 401, 402, 411, 412, and 441 or equivalent courses. It is strongly recommended that Physics 403, 413, and 461 be included. A thesis is optional. If it is elected, a maximum of 12 quarter hours may be allowed as a combined total for Physics 497, Independent Study and Physics 499, Thesis Research; if a thesis is not elected, a maximum of 8 quarter hours may be allowed for Physics 497.

### Doctor of Philosophy

The minimum requirements for the Ph.D. in physics are: satisfactory completion of at least 144 quarter hours of approved course work beyond the bachelor's degree, including those eight courses required or recommended for the M.S.; passing a written and oral qualifying examination covering mechanics, electrodynamics, quantum mechanics, statistical physics and elementary modern physics at the level of advanced undergraduate courses, the graduate courses required for the M.S. and Physics 461; passing a preliminary examination after the completion of all course work; and passing a final oral examination on a thesis acceptable to the examining committee. A maximum of 48 quarter hours are allowed for Physics 499; a combined maximum of 64 quarter hours may be allowed for Physics 497 and Physics 499. There is no foreign language proficiency requirement.

## Courses for Graduate and Advanced Undergraduate Students

301. **Electricity and Magnetism I. 4 hours.** Credit is not given to graduate physics majors. Vector calculus; electrostatic potential and fields in vacuum and material media; energy concepts; boundary value problems. Prerequisites: Phys. 114 and Math. 321.
302. **Electricity and Magnetism II. 4 hours.** Credit is not given to graduate physics majors. Magnetostatics; vector potential; magnetic materials; time-varying fields and electromagnetic induction; Maxwell's equations. Prerequisite: Phys. 301.
303. **Electricity and Magnetism III. 4 hours.** Propagation of electromagnetic waves; reflection, refraction, and dispersion; guided waves; radiation; selected topics. Prerequisite: Phys. 302.
304. **Electronics I. 4 hours.** Theory of electronic devices, linear and nonlinear analysis, applications of vacuum and semiconductor devices to circuits, amplifiers, biasing, feedback, oscillators, and special circuits. Prerequisite: Phys. 301. Physics 302 and 303 are recommended.
305. **Electronics II. 4 hours.** Pulse-shaping networks, logic circuits, control circuits, distributed amplifiers, special problems of transducers, special signal-to-noise techniques. Prerequisite: Phys. 304.
321. **Quantum Mechanics I. 4 hours.** The basic theory of the mechanics governing microscopic systems. Wave functions; probability density; operators; the Schrodinger equation with examples in one and three dimensions. Prerequisites: Phys. 114, 221 or approval of the department, and Math. 220. Credit or registration in Mathematics 310 is recommended.
322. **Quantum Mechanics II. 4 hours.** Mathematical structure of quantum mechanics; observables for a quantum state; angular momentum; perturbation theory; the Born approximation; the variational method; transition probabilities. Prerequisite: Phys. 321. Credit or registration in Mathematics 311 is recommended.
323. **Elementary Solid State Physics. 4 hours.** Crystal structure, thermal and dielectric properties of solids, free electron model of metals, band theory, semiconductor physics, dislocations and strength of solids. Individual projects are required. Prerequisite: Phys. 322.
331. **Nuclear Physics. 4 hours.** Natural and artificial radioactivity, equipment for studying and producing high-energy particles, nuclear disintegrations, interaction of nuclear particles with each other and with matter, cosmic rays, mesons, recent developments in high-energy physics. Individual projects are required. Prerequisite: Phys. 321.
341. **Theoretical Mechanics I. 4 hours.** Credit is not given to graduate physics majors. Motion of a particle in one, two, and three dimensions, Kepler's laws and planetary motion, scattering of particles, conversion between laboratory and

center of mass coordinate systems, conservation laws, motion of a rigid body in two dimensions. Individual projects are required. Prerequisites: Phys. 114 or approval of the department; Math. 220.

342. **Theoretical Mechanics II. 4 hours.** Statics of extended systems, moving coordinate frames, fictitious forces and conservation laws, special theory of relativity, mechanics of continuous media. Individual projects are required. Prerequisite: Phys. 341.
343. **Theoretical Mechanics III. 4 hours.** Rigid-body motion in three dimensions, motion in gravitational fields, generalized coordinates and Lagrange and Hamilton equations, equations of constraint, small-vibration theory. Individual projects are required. Prerequisite: Phys. 342.
361. **Thermodynamics. 4 hours.** Thermodynamic variables, equilibrium, zeroth law of thermodynamics, isolated systems, the first law, Kelvin and Clausius statements of second law, Clausius inequality, irreversible processes, thermodynamic potentials, Maxwell relations, stability criteria, equations of state, Clausius-Clapeyron equation, multicomponent systems, the third law, selected applications to physical systems. Prerequisite: Phys. 114.
362. **Statistical Physics. 4 hours.** Kinetic theory of dilute gases, elementary statistical concepts, equilibrium between interacting systems; temperature, entropy, statistical calculation of thermodynamic quantities, the microcanonical and canonical ensembles, quantum statistics of ideal gases, selected applications to physical systems. Prerequisite: Phys. 361.
371. **Light (Wave Optics). 4 hours, lectures and laboratory; 2 hours, lectures only.** Wave propagation and Maxwell's equations, interference and interferometers, gratings, circular aperture, echelon, resolving power. Prerequisite: Phys. 114 and credit or registration in Math. 220.
372. **Light (Modern Optics) I. 4 hours, lecture and laboratory; 2 hours, lecture only.** Crystals, polarized light, optics of metals, quantum theory of radiation, transition probability and oscillator strength, dispersion and scattering theory. Prerequisite: Phys. 371.
373. **Light (Modern Optics) II. 4 hours.** Individual projects are required. Gaussian optics and general laws, special optical systems and applications. Image formation, finite image-error theory, spot diagrams. Necessary mathematical tools for Fourier analysis and transfer functions. Prerequisite: Phys. 372.
381. **Modern Experimental Physics I. 4 hours, lecture and laboratory; 1 hour, lecture only.** Techniques and experiments in the physics of atoms, atomic nuclei, molecules, the solid state, and other areas of modern physical research. Prerequisites: Phys. 304 and 331.
382. **Modern Experimental Physics II. 4 hours.** Continues Physics 381. Lecture and laboratory. Prerequisite: Phys. 381.

## Courses for Graduate Students

401. **Electrodynamics I. 4 hours.** Maxwell's equations; static and time-dependent fields; boundary value problems; wave propagation. Prerequisite: Phys. 303 or approval of the department.
402. **Electrodynamics II. 4 hours.** Classical theory of radiation; radiation reaction; special relativity; covariant formulation of electrodynamics. Prerequisite: Phys. 401 or approval of the department.
403. **Electrodynamics III. 4 hours.** Lagrangian formulation of electrodynamics; action principles; special topics in electromagnetic theory. Prerequisite: Phys. 402 or approval of the department.
411. **Quantum Mechanics I. 4 hours.** Wave functions, uncertainty principle and Schrodinger equation, one and three-dimensional one-particle problems, approximate methods. Prerequisite: Phys. 322 or approval of the department.
412. **Quantum Mechanics II. 4 hours.** Operators and Hilbert space formulation, symmetries and conservation laws, angular momentum and rotations, coupling of angular momenta, spherical tensors, scattering, phase shifts, Born series, scattering in Coulomb field, inelastic scattering. Prerequisite: Phys. 411 or approval of the department.
413. **Quantum Mechanics III. 4 hours.** Introduction to formal theory of scattering,  $S$ -matrix, time-dependent and independent formulations of scattering, introduction to relativistic quantum mechanics, Klein-Gordon and Dirac equations, introduction to quantum field theory, electromagnetic transitions, particles and antiparticles. Prerequisite: Phys. 412 or approval of the department.
414. **Advanced Quantum Mechanics I. 4 hours.** Canonical quantum field theory, quantization of the electromagnetic field, the Dirac field, the scalar and pseudoscalar meson fields, the interactions of quantum fields with classical fields. Prerequisite: Phys. 413 or approval of the department.
415. **Advanced Quantum Mechanics II. 4 hours.** Interacting quantum fields, the  $S$ -matrix, the Dyson expansion and diagrams, applications to problems in quantum electrodynamics, renormalization and its physical interpretation. Prerequisite: Phys. 414 or approval of the department.
421. **Atomic and Molecular Physics I. 4 hours.** Hydrogen atom and one-electron systems, helium atom, self-consistent field theory, alkali spectra, vector model, Zeeman and Stark effects, fine and hyperfine structure, collisions, ionization. Prerequisite: Phys. 322 or approval of the department.
422. **Atomic and Molecular Physics II. 4 hours.** Rotation and vibrational energies of diatomic molecules, potential curves, electronic transitions and transition moments, intensities, thermodynamic properties, applications. Prerequisite: Phys. 322 or approval of the department.



423. **Atomic and Molecular Physics III. 4 hours.** Structure and symmetry of molecules, vibrational and rotational spectra, experimental infrared and Raman spectra, chemical bonding, molecular interactions, molecular collisions, intermolecular potentials, relaxation phenomena. Prerequisite: Phys. 322 or approval of the department.
425. **Solid State Physics I. 4 hours.** Crystal structure, X-ray methods, crystal forces, lattice theory, vibrations, heat conductivity. Prerequisite: Phys. 323 or approval of the department.
426. **Solid State Physics II. 4 hours.** Electric and magnetic properties of solids, free-electron model of metals, quantum statistics, band theory, order-disorder theory. Prerequisite: Phys. 425 or approval of the department.
427. **Solid State Physics III. 4 hours.** Semiconductors, ferromagnetism and antiferromagnetism, superconductivity, lattice vacancies, color centers, excitons, luminescence. Prerequisite: Phys. 426 or approval of the department.
428. **Quantum Theory of Solids I. 4 hours.** Introduction to quantum mechanics of noninteracting particles in a periodic potential, band structure of solids, optical properties of solids, dynamics of electrons in a magnetic field and a crystal potential. Prerequisites: Phys. 412, 427, and 461, or approval of the department.
429. **Quantum Theory of Solids II. 4 hours.** The electron-phonon interaction, collective excitations in solids, phonons, plasmons, polarons, magnons, excitons, quasiparticles, Landau theory of the Fermi liquid, the Hartree-Fock, RPA, and SCF approximations, generalized susceptibility, introduction to Green's functions, and diagrammatic techniques in solids. Prerequisite: Phys. 428 or approval of the department.
430. **Quantum Theory of Solids III. 4 hours.** May be repeated for credit by arrangement with the department. Topics will vary from year to year. Special topics in the modern theory of solids, superconductivity, ferromagnetism, liquid helium, theory of alloys, theory of liquids, theory of defects in semiconductors, applications of group theory to solid state physics, etc. Prerequisite: Phys. 429 or approval of the department.
431. **Elementary Particle and Nuclear Physics I. 4 hours.** Two-nucleon system: properties of the deuteron, nucleon-nucleon scattering, nuclear forces. Properties of pions and pion-nucleon scattering, other nonstrange mesons; introduction to strange particles and higher symmetries. Prerequisite: Phys. 412 or approval of the department.
432. **Elementary Particle and Nuclear Physics II. 4 hours.** General properties of nuclei: sizes, binding energies, stability, saturation. Introduction to nuclear models and structure. Beta decay and weak interactions. Prerequisite: Phys. 431 or approval of the department.
433. **Nuclear Physics I. 4 hours.** Review of two-nucleon system and nuclear forces, nuclear models and nuclear spectroscopy. Individual-particle model, collective model, particle-hole excitations, pairing, electromagnetic interactions. Prerequisites: Phys. 413 and 432, or approval of the department.

434. **Nuclear Physics II. 4 hours.** Nuclear reactions: compound nucleus, optical model, direct reactions. Nuclear forces and nuclear structure; light nuclei, nuclear many-body problem; nucleon-nucleus scattering at high energies. Interactions of particles other than nucleons with nuclei. Prerequisite: Phys. 433 or approval of the department.
435. **Elementary Particle Physics I. 4 hours.** Fields and invariance principles, relativistic kinematics and scattering, strong and electromagnetic interactions of nonstrange particles. Pions and nucleons, resonances, introduction to dispersion relations, one-particle exchanges, electromagnetic form factors. Prerequisites: Phys. 413 and 432, or approval of the department.
436. **Elementary Particles II. 4 hours.** Strong interactions of strange particles; higher symmetries; weak interactions of nonstrange and of strange particles. Prerequisite: Phys. 435 or approval of the department.
441. **Classical Mechanics. 4 hours.** Variational principles; Lagrange and Hamilton equations; Hamilton-Jacobi theory; rigid body motion; small oscillations; continuous systems and fields. Prerequisite: Phys. 343 or approval of the department.
445. **Introduction to General Relativity. 4 hours.** Deficiencies of Newtonian gravitational theory, principle of equivalence, the metric field and geodesics, tensor analysis and differential geometry, Einstein's equations and the action principle, the energy-momentum pseudotensor, gravitational fields and waves. Prerequisites: Phys. 402 and 441 or approval of the department.
461. **Statistical Mechanics. 4 hours.** Classical and quantum-statistical mechanics; Maxwell, Bose, and Fermi statistics; ensemble theory; imperfect gas; selected applications. Prerequisite: Phys. 361 or approval of the department.
481. **Mathematical Methods of Physics I. 4 hours.** Introduction to the linear methods of mathematical physics from the modern point of view. Mathematical foundations of quantum theory; classical problems of differential equations. Prerequisite: Approval of the department.
482. **Mathematical Methods of Physics II. 4 hours.** Applications of linear analysis to ordinary and partial differential equations and integral equations. Properties of classical special functions and generalized functions. Prerequisite: Phys. 481 or approval of the department.
491. **Graduate Seminar. 1 to 2 hours.** May be repeated for a total of 6 hours. Seminars are organized in areas of research activity within the department and cover recent contributions to the literature and research in progress. Students, faculty, and scientists from other institutions make presentations. Prerequisites: Phys. 411 and 412.
497. **Individual Study. 2 to 4 hours.** Special topics. Outside reading and term paper will be assigned by special arrangement with the department and faculty. Prerequisite: Approval of the department.

498. **Special Topics in Modern Physics.** 1 to 4 hours. Students may enroll in more than one section of this course concurrently. Lectures on topics of current interest. Subjects are announced. Prerequisites: Phys. 411 and 412.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Approval of the department.

## POLITICAL SCIENCE

**Professors:** Richard M. Johnson, Head of the Department; Hollis W. Barber, Twiley W. Barker, Doris A. Graber, Boyd R. Keenan, Milton Rakove

**Associate Professors:** George D. Beam, Leonard E. Goodall, Lyman A. Kellstedt, Byung C. Koh, David C. Leege, Frank Tachau

**Assistant Professors:** Catherine M. Kelleher, Peter R. Knauss, Michael A. Murray, Dick W. Simpson

An applicant usually must present a bachelor's degree with a major in political science or a bachelor's degree with a minimum of 20 quarter hours in political science, or petition the department to be admitted.

Applications for entrance with advanced graduate standing will be considered on the basis of individual preparation and merit.

All applicants are required to take the Aptitude Test and the Advanced Political Science Test of the Graduate Record Examination. Information about this examination can be obtained from the head of the Department of Political Science. Performance on this examination, undergraduate academic record, and letters of recommendation from former teachers are the three principal kinds of evidence considered in making decisions about admission and in the awarding of assistantships. It is particularly advantageous, therefore, for the prospective applicant to take this examination in the fall of his senior year.

## Degree Requirements

The department offers courses leading to the Master of Arts. The minimum requirements for the M.A. are:

48 quarter hours beyond the bachelor's degree for students electing the non-thesis option and 40 hours for students who elect to write a thesis.

Usually, at least two courses outside the department.

Political Science 390, Scope and Methods of Political Science, or the equivalent.

A reading knowledge of French, German, Russian, or Spanish or demonstrated competence in statistics or another acceptable research tool.

Three quarters of residence, not necessarily consecutive, with 24 quarter hours taken in residence.

For those selecting the non-thesis option:

48 quarter hours of course work, which include at least 24 quarter hours of 400-level courses.

For those selecting the thesis option, a thesis for which 12 quarter hours of thesis research credit is awarded, and an oral examination on the thesis upon its completion.

## Courses for Graduate and Advanced Undergraduate Students

301. **Educational Policy in Urban America.** 4 hours. Same as Education 301. Examination of selected urban phenomena in relation to educational bureaucracies and school socialization processes. Emphasis on historical investigation of strategies for protest and change employed by ghetto populations; conditions which fostered these strategies; responses of schools and other target institutions; social-philosophical analysis of ideologies supporting both protest and response. Prerequisites: One course in the social foundations of education or the equivalent and consent of the instructor.
305. **Local Political Decision Making.** 4 hours. A research seminar. The problem of identifying and investigating political decisions in a major urban area like Chicago; an attempt is made to apply different theories of decision making to local politics. Prerequisites: PolS. 120 or 150 and consent of the instructor.
306. **Ghetto Politics.** 4 hours. Individual conferences on assigned papers are required. Analysis of the political impact of the ghetto on local, state, and national political systems; the impotency of the ghetto voter; the ghetto politician; ghetto riots as political protest; the ghetto and presidential politics. Prerequisite: Three courses in political science, American history, or sociology.
307. **Urban Politics Seminar.** 4 hours. Analysis of the structure and dynamics of political parties and organizations in urban areas. Intensive study of the power structure, strength, and weakness of the Democratic and Republican parties in urban areas, using Chicago and its suburbs as a laboratory. Prerequisites: PolS. 205 and consent of the instructor.
311. **Studies in Urban Public Policies.** 4 hours. The problems of governing metropolitan areas; special emphasis on evolving patterns of cooperation among governments in metropolitan areas, such as metropolitan federalism, city-county consolidation, councils of governments, and regional planning commissions. Prerequisite: PolS. 120 or 205.
315. **Legislatures and Legislation.** 4 hours. The legislative function in government; structure and organization of American legislatures, national, state, and local; party organization in legislatures; legislative procedure; pressure groups and lobbying; relation of legislature to other branches of government; problems of legislative reorganization. Prerequisite: PolS. 120 or 150.



316. **The President and Congress.** 4 hours. Analysis of the relationship of the President and Congress; problems involved in the formulation and execution of public policy. Prerequisite: PolS. 120 or 150.
317. **Intergovernmental Relations.** 4 hours. The origin and evolution of the American federal system; federal-state constitutional relationships; intergovernmental fiscal relations; the political cultures; interstate relations; regionalism; state-local relations, interlocal relations and cooperative federalism in functional areas. Prerequisites: PolS. 151; 205 or 212.
318. **Science, Technology, and Public Policy.** 4 hours. The impact of science and technology on government policy in the United States. Responses of the national executive and legislative branches of government; intergovernmental aspects of technological advances. Prerequisites: PolS. 151 and one advanced political science course.
319. **The Public Administration of Science and Technology.** 4 hours. The response of public systems to the scientific and technological revolution; the governmental institutions being devised to administer science and technology in the public sector. Emphasis on technological problems caused by the emergence of new metropolitan communities.
327. **Public Opinion and Political Communication.** 4 hours. The nature of public opinion and political communication systems; patterns of opinion distribution and techniques for opinion measurement; forces shaping public opinion, with emphasis on the mass media; the impact of public opinion on public policy; comparison of political communication patterns in the United States with less developed and totalitarian nations. Prerequisite: 6 hours of advanced political science, sociology, or modern history.
328. **Propaganda and the Language of Politics.** 4 hours. The nature of propaganda, political symbols, and the language of politics; the uses of political symbols and propaganda in the political processes of democratic and totalitarian societies; international propaganda and psychological warfare; methods and uses of propaganda analysis. Prerequisite: Two courses in advanced political science, sociology, or modern history.
331. **Electoral Behavior.** 4 hours. Emphasizes two aspects of the study of electoral behavior: social, economic, and psychological theories developed specifically for, or adaptable to, the explanation of electoral behavior; introduction to inductive studies of voting behavior. Prerequisite: PolS. 230.
332. **Quantitative Study of International Politics.** 4 hours. The usefulness of statistical reasoning in making inferences about international politics. Political decision making, political conflict and cooperation, and political development and change in terms of three basic levels of analysis: multinational organization, nations, and international relations. Prerequisites: PolS. 184 and consent of the instructor.

334. **Political Socialization. 4 hours.** Introduction to the problems of how people learn about the polity; from whom they learn, under what circumstances, and with what consequences. Prerequisite: Three courses in political science, including at least one dealing with human political behavior.
335. **Quantitative Study of Politics. 4 hours.** Introduction to descriptive and inductive techniques essential for understanding behavioral political science. Especially recommended for students who plan to take advanced courses in political behavior and related subjects. Prerequisite: PolS. 390.
336. **Film as a Research Technology in the Social Sciences. 4 hours.** The techniques and problems of film as a technology for generating, interpreting, and presenting data. Prerequisite: Consent of the instructor.
337. **The Politics of Alienation. 4 hours.** Conceptual, empirical, and normative analysis of alienation from polity, society, culture, and self. Focus on the political consequences of various forms of alienation, including radicalism, apathy, protest, revolution, renewal, and innovation. Empirical research is required. Prerequisite: PolS. 230.
351. **Constitutional Law. 4 hours.** Constitutional provisions and principles as they have developed through Supreme Court interpretation; the amending process; federalism; commerce, taxing, and war powers; due process of law; the constitutional relations between the three major branches of government. Prerequisite: At least one introductory political science course.
353. **Seminar: Problems of Constitutional Law. 4 hours.** Supervised individual study of selected problems arising in the interpretation of the United States Constitution. Prerequisites: PolS. 351 or 355 and consent of the instructor.
355. **The Constitution and Civil Liberties. 4 hours.** The nature and constitutional positions of freedom of religion, speech, press, and others; varying interpretations of these freedoms; difficulties encountered in protecting them; problems of discrimination against racial, religious, and other minorities. Prerequisite: PolS. 151.
356. **Administrative Law. 4 hours.** Legal problems arising in the relationships between the citizen and the government official; administrative rule making and enforcement; judicial review of administrative actions. Prerequisite: Consent of the instructor.
362. **Seminar: Public Administration. 4 hours.** Supervised individual study of selected problems. Prerequisite: PolS. 261 or 263.
370. **Practicum in Teaching Political Science. 4 hours.** Provides seniors and graduate students with a limited exposure to teaching political science by leading discussion sections of undergraduate courses at the same time that they participate in a seminar on the problems and methods of teaching in the field. Teaching assistants may not receive credit for this course unless they actually teach discussion sections and are enrolled in the seminar. Prerequisites: Senior or graduate-student standing, at least a B average in political science courses, and consent of the instructor.

381. **Seminar: Political Problems of Developing Societies.** 4 hours. Selected aspects of the politics of the countries of Asia, Africa, and Latin America. Prerequisite: PolS. 280.
386. **Problems in International Organization.** 4 hours. May be repeated once for credit. Subject matter varies from quarter to quarter, but centers around one group of related problems pertaining to the United Nations or other international organizations. Prerequisite: Two courses in international politics or international organization. Political Science 184 and 286 are recommended.
388. **Seminar: Problems in American Foreign Relations.** 4 hours. Supervised individual study of selected problems of contemporary United States foreign relations. Prerequisite: PolS. 281 or 184.
390. **Scope and Methods of Political Science.** 4 hours. Examination of the scope and subject matter of political science. Special attention to analytic processes in the development of concepts, hypotheses, and theories. Methodologies and modes of analysis now in use by political scientists. Prerequisites: PolS. 120 or 151 and one 200-level course in political science.
391. **Political Power.** 4 hours. Examination of the problem of the nature of political power. Introduction to some of the major literature of power, and the development of the concept of political power as a descriptive category adequate to the comparative analysis of broader political phenomena, such as parties, official decision-making structures, and movements. Prerequisites: PolS. 120 or 150 and 4 hours of upper-division political science courses.
392. **Democratic Theory.** 4 hours. Democracy as a procedure of government and the value commitments associated with this form of government. Special attention is given to corporate wealth, special interests, bureaucracy, and the mass media as they affect the existence of democratic government.
395. **Political Violence.** 4 hours. Seminar. Analysis of the use, or threat, of violence in the political process. Attention is focused on domestic forms of violence and aggression in various nations viewed cross-culturally. Prerequisites: PolS. 150 or 151, two 4-hour courses in the social sciences, and consent of the instructor.
398. **The Problem of Justice.** 4 hours. Same as Administration of Criminal Justice 398. The premodern understanding of justice, Plato's or Aristotle's; the modern understanding of justice, such as Hobbes' or Locke's, which is the foundation of the modern political regime; Rousseau's seminal political thought on justice, which is the basis of a variety of reforms and alternatives offered to Hobbes' and/or Locke's political regime. Prerequisite: Two courses in political science including PolS. 151.
399. **Seminar in Political Theory.** 4 hours. May be repeated for a total of 8 hours. In-depth analysis and discussion of selected problems or works in political theory. Prerequisites: PolS. 290, 291, and 292.



## Courses for Graduate Students

408. **Government and Politics of Chicago.** 4 hours. The political process in Chicago, including an analysis of the city government and other governments, such as the Park and Sanitary Districts. The role of the political parties, business and civil leaders, the press, and other factors involved in the governmental process. Prerequisite: PolS. 205.
409. **Suburban Government and Politics.** 4 hours. Examination of government and politics in suburban America. Particular attention is given to party structure, financing of governmental units, and the patterns of political competition in the suburbs. Prerequisite: PolS. 205.
412. **Problems in State Government.** 4 hours. Case analysis and research in selected problems dealing with the structure, functions, and administrative processes of American state governments. Prerequisite: PolS. 317 or 362.
415. **Urban Management Processes.** 4 hours. The political and administrative aspects of managing the urban environment. The course is designed to give the student a view of the specific tasks that face urban executives, such as mayors, city managers, and department heads. Prerequisite: PolS. 212 or 317.
417. **Seminar in Legislation and Public Policy.** 4 hours. Intensive study of the institutional and dynamic forces that affect public policy making in the United States. Emphasis on the separation of powers and the role of pressure groups, public opinion, and organizational bureaucracies as they affect the decision-making process. Prerequisite: PolS. 315 or 316.
420. **Special Problems in Urban Government.** 4 hours. Intensive study of selected current problems. Maximum emphasis on providing the student with an opportunity to undertake and report on independent research. Prerequisite: PolS. 205.
451. **Problems in American Constitutional Law.** 4 hours. Research in selected problems evolving from conflicting interpretations of the United States Constitution. Prerequisite: PolS. 351 or 355 or the equivalents.
461. **Special Topics in Public Administration.** 4 hours. Analysis of selected problems. Topics considered vary from year to year, depending upon the needs and interests of the students. Prerequisite: PolS. 261.
462. **Seminar in Administrative Theory and Behavior.** 4 hours. Analysis of the theory of bureaucratic organization in several substantive areas. The nature and function of theory in administrative study; basic concepts, hypotheses, and research findings in organizational theory and behavior; leadership theory, decision making; organizational authority; patterns of accommodation between the organization and its members. Prerequisite: PolS. 261. Political Science 329 is recommended.
463. **Seminar: Comparative and International Administration.** 4 hours. Supervised individual study of selected problems. Prerequisite: PolS. 363.



465. **Seminar in Politics and Administration.** 4 hours. The interplay between politics and administration. The manner in which politics shape and condition public administration and vice versa. Both theoretical materials and empirical case studies will be examined. Prerequisite: PolS. 261.
497. **Directed Readings in Political Science.** 4 hours. May be repeated for a maximum of 8 hours. Intensive readings on a topic not covered in the regular curriculum. Prerequisite: Consent of the instructor.
498. **Independent Research in Political Science.** 2 to 8 hours. May be repeated for a maximum of 8 hours. Research on special problems not included in the regular course offerings. The work undertaken for this course may not duplicate that being done for Political Science 499. Prerequisite: Consent of the instructor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Open only to degree candidates. Individual study and research required of all students pursuing the advanced degree in political science under the thesis option.

## PSYCHOLOGY

**Professors:** Harry S. Upshaw, Head of the Department; Philip Ash, Rosalind D. Cartwright, John D. Davis, Leonard D. Eron, Isadore E. Farber, Susan M. Markle, Sheldon Rosenberg

**Associate Professors:** Gershon B. Berkson, Roger L. Dominowski, Philip E. Freedman, Nan E. McGehee, Gerald Senf, Herbert H. Stenson, Robert S. Wyer

**Assistant Professors:** Alan Benton, Charles L. Gruder, Ernest W. Kent, Leonard P. Kroecker, Leon K. Miller, Rolf Peterson, Alexander J. Rosen, Elliot L. Rubin

The department offers work leading to the Master of Arts and the Doctor of Philosophy.

## Admission Requirements

Minimum departmental requirements are as follows:

- A. A grade-point average of 4.200 (on a 5.000 scale) for both the last two years of undergraduate study and for all graduate work. A student whose average is between 4.200 and 4.000 may be considered on the basis of individual merit.
- B. The equivalent of 24 quarter hours in psychology, including statistics and a laboratory course in experimental psychology, one year of college mathematics, and one year of laboratory courses in physical and/or biological

sciences. Students with exceptionally high grade-point averages and/or scores on the Graduate Record Examination who do not fulfill all course requirements may be admitted provisionally, pending satisfactory completion of the course requirements without graduate credit.

C. Satisfactory scores on the Graduate Record Examination aptitude tests (verbal and quantitative) and the advanced test in psychology. Standards of acceptable performance on the advanced test may be modified for undergraduate majors in fields other than psychology if they are otherwise especially well qualified.

D. Satisfactory ratings by three faculty members, preferably psychologists, who are familiar with the applicant's training and ability. In the case of candidates who have been engaged in professional work for some years, ratings by supervisors may be substituted.

Graduate admissions are limited; therefore, it may not be possible to accept all applicants who meet the foregoing minimum requirements. Preference will be given to candidates particularly well qualified in quantitative and experimental psychology and in the natural sciences.

Special consideration is given both in admissions and in planning an academic program to students who are judged especially likely to succeed although their status on standard admissions criteria is below that which is normally acceptable. Minority group members who may have experienced educational disadvantage are encouraged to apply under this provision.

Although applications may be accepted up to the time of the Graduate College deadline, students who expect to enter the department's program in the fall are advised to complete their applications as early as possible, preferably by March 15, and no later than May 1. Completed application materials must include applications for admission and for graduate appointment, referees' ratings, official transcripts, and GRE scores.

## Degree Requirements

The department offers work leading to the Master of Arts and the Doctor of Philosophy. The faculty of the department is organized into an undergraduate division, and nine graduate divisions, corresponding to substantive and curricular interests. Six of the divisions correspond to broad, substantive areas: cognitive psychology, developmental psychology, learning-motivation, methodology and measurement, physiological psychology, and social psychology. Three of the divisions correspond to the types of graduate curriculum that the department offers: the academic curriculum, the clinical curriculum, and the organizational curriculum, under which specialties are available in industrial psychology, in institutions of higher education and in school psychology. Course requirements have been established for each division. Students elect one substantive and one curricular division. Usually, this election determines the program of study.

## Master of Arts

A candidate must complete 48 quarter hours of graduate-level course work (including research) and present an acceptable thesis. At least 16 quarter hours must be in one of the six substantive divisions. This program will be established by the division. The candidate must also complete Psychology 343.

## Doctor of Philosophy

A candidate must complete 144 quarter hours of graduate-level course work (including research). In addition, he must have completed a master's thesis or its equivalent and must pass preliminary examinations, demonstrate proficiency in special research skills, and present an acceptable dissertation. Courses offered in fulfillment of these requirements must include Psychology 343, 370, 443, 444, and the programs of one of the substantive divisions and of one of the three curriculum divisions. The candidate must also complete at least two courses in each of two cognate areas, these courses and areas to be specified by the substantive division. Basic skill in computer usage is required of all candidates. Proficiency in one of the following is also required: a foreign language, laboratory instrumentation, or psychometric instrument construction.

## Courses for Graduate and Advanced Undergraduate Students

310. **Advanced Social Psychology.** 4 hours. Same as Sociology 315. Critical analysis of empirical research on social perception, communication and influence, group structure, role analysis, and socialization processes.
313. **Social Judgment.** 4 hours. Analysis of the judgment process and its implications for social psychological phenomena.
314. **Attitude Change.** 4 hours. Critical analysis of selected contemporary theory and research on attitude change. Topics include source and message effects, determinants of persistence of change and resistance to change.
315. **Cognitive Consistency Processes.** 4 hours. Critical analysis of research and theory related to the processes of information integration and its implications for attitude and opinion change. Emphasis on cognitive consistency formulations and their derivatives.
316. **Animal Behavior.** 4 hours. Principles and methods in the study of animal behavior; review of the social behavior of representative species in various phyla. Prerequisites: BioS. 100, 101, 102, and Psch. 143.
323. **Psychology of the Exceptional Child.** 4 hours. Methods, results, and interpretation of studies of physically, intellectually, and emotionally deviant children,



with special reference to their implications for education and behavior modification. Prerequisite: 12 hours of psychology including Psch. 220 or the equivalent.

330. **Organizational Psychology.** 4 hours. Same as Management 30. Individual psychological and group processes and their interaction with organizational structure. Behavioral factors in effective organizational change.
332. **Personnel Psychology.** 4 hours. Systematic study of the development and utilization of psychological techniques of personnel selection, classification, and assessment.
333. **Motivation and Morale in Organizations.** 4 hours. Same as Management 333. Concepts and methods in the assessment and modification of motivation, attitudes, and morale.
335. **Psychology of Industrial Training.** 4 hours. Same as Management 335. Psychological measurement techniques in assessing training needs and evaluating training effectiveness. Application of psychological techniques to the development of industrial training programs.
338. **Psychology of Industrial Conflict.** 4 hours. Same as Management 338. Behavioral analysis of the causes, dimensions, and modes of resolution of industrial conflict; special emphasis on labor-management relations.
343. **Advanced Statistics I.** 4 hours. Elementary probability theory, empirical and theoretical distributions, points and interval estimation, hypotheses testing.
345. **Psychometric Applications.** 4 hours. Theory of psychological tests and measurement applied to problems of ability and personality testing; opinion sampling; reliability and validity; prediction and selection processes.
350. **Learning and Conditioning.** 4 hours. Methods, results, and interpretation of experimental studies of basic learning processes in animal and human subjects.
351. **Programmed Learning.** 4 hours. Theory and research in the techniques, applications, and results of programmed instruction.
352. **Motivation.** 4 hours. Methods, results, and interpretation of experimental studies of basic motivational processes in animal and human subjects.
353. **Operant Conditioning.** 4 hours. Survey of basic principles and current research in the area of operant behavior.
354. **The Psychology of Language.** 4 hours. Same as Linguistics 354 and Speech and Theater 354. Introductory survey of methods, theory, and research; acquaints students with the history and present status of psychology's interest in language behavior.
355. **Higher Processes.** 4 hours. Methods, results, and interpretations of experimental studies of language behavior, problem solving, concept formation, and creativity.



- 356. **Sensory and Perceptual Processes I. 4 hours.** Methods, results, and interpretation of experimental studies dealing with the determination of psycho-physical functions. Primary emphasis on the perception of single discrete stimuli and attributes of stimuli.
- 357. **Sensory and Perceptual Processes II. 4 hours.** Methods, results, and interpretation of experimental studies dealing primarily with the role of contextual and experimental factors in perception.
- 360. **Human Factors. 4 hours.** Application of experimentally derived principles of behavior to the design of equipment for efficient use and operation. Sensory and perceptual processes, motor skills, and experimental methodology.
- 361. **Instrumentation in Psychology. 4 hours.** Use of transducers, programming equipment, and recording systems in psychological research.
- 362. **Physiological Psychology. 4 hours.** Methods, results, and interpretation of experimental studies of physiological and neurochemical correlates of learning, motivation, and perception. Laboratory demonstrations and problems.
- 363. **Behavioral Pharmacology. 4 hours.** Methods, results, and interpretation of experimental studies dealing with drugs and behavior. Emphasis on elucidating the role of drugs as tools in behavioral research and on the use of experimental psychology techniques to explicate drug action.
- 370. **Systems and Theories. 4 hours.** Critical introductory analysis of major historical systems and their representation in current theoretical issues.
- 382. **Introduction to Clinical Psychology. 4 hours.** Systematic analysis of the nature of psychological tests and their application; introduction to intelligence, achievement, personality, and interest tests. Practice in administration and interpretation.
- 399. **Problems in Psychology. 2 to 12 hours.** May be repeated. Investigation of special problems under the direction of a staff member. Prerequisites: Consent of the instructor and of the head of the department.

## Courses for Graduate Students

**Note:** The prerequisites stated apply to graduate majors in psychology. Students minoring in psychology or majoring in related fields may, with the consent of the instructor, enroll in certain courses without having met all prerequisites.

- 401. **Experimental Psycholinguistics. 4 hours.** Same as Linguistics 401 and Speech and Theater 401. Intensive review of experimental laboratory studies concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature user of language. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisites: Psch. 354 or the equivalent and consent of the instructor.

409. **Seminar in Cognitive Psychology.** 4 hours. May be repeated. Systematic review of special topics; emphasis on current research and theoretical developments. Prerequisite: Consent of the instructor.
410. **Experimental Approaches to Personality.** 4 hours. Analysis of empirical and theoretical advances in experimental research in personality. Emphasis on the interaction of experimental factors in learning, motivation, and cognition with individual differences variables. Prerequisite: Consent of the instructor.
411. **Small Groups: Structure and Process.** 4 hours. Same as Sociology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.
412. **Research Methods in Social Psychology.** 4 hours. Principles of design, data collection, and analysis of social psychological research in the laboratory and in naturalistic settings. Prerequisite: Psych. 444.
416. **Theories of Social Behavior.** 4 hours. Current theoretical formulations and relevant data concerning major aspects of social behavior. Prerequisite: Psych. 310 or the equivalent.
419. **Seminar in Social Psychology.** 2 hours. May be repeated for credit. Critical discussion of selected topics, such as social judgment, group processes, attitude formation and change. Content will vary. Prerequisites: Relevant 300-level or 400-level courses in social psychology and consent of the instructor.
420. **Advanced Developmental Psychology.** 4 hours. Theory and research on psychological development through adolescence; physical, mental, and social growth. Prerequisites: Psych. 220 or the equivalent and consent of the instructor.
421. **Developmental Psychology.** 4 hours. Review of theories of behavioral development from a biological orientation. Prerequisites: Psych. 420 and consent of the instructor.
423. **Perceptual Development.** 4 hours. Examination of contemporary theory and research dealing with the assessment and development of perceptual capacities in children. Prerequisites: Psych. 357 and 420.
424. **Social Development.** 4 hours. Discussion at an advanced level of processes and substantive areas of social development; major stress on social learning theory, socialization, dependency, identification, and cognitive-developmental processes as they influence social development. Participation in a small research or interview project is required. Prerequisite: Psych. 420.
425. **Practicum in Developmental Psychology.** 2 hours. May be repeated. Supervised practice in the observation and assessment of behavior development in naturalistic settings, including preschool, grade school, and special treatment units. Normal and exceptional children and adolescents. Prerequisites: Psych. 420 or the equivalent and consent of the instructor.

427. **Developmental Psycholinguistics.** 4 hours. Same as Linguistics 427. Theoretical formulation, research methods, and research findings in the area of language development. Biological foundations and environmental influences; disorders of language development. Prerequisites: Psch. 354 or the equivalent and consent of the instructor.
429. **Seminar in Developmental Psychology.** 2 hours. May be repeated. Systematic review of special topics; emphasis on current research. Prerequisites: Psch. 420 or the equivalent and consent of the instructor.
430. **Psychological Counseling.** 4 hours. Basic principles, practices, and theories of counseling. Prerequisite: Consent of the instructor.
434. **Practicum in Organizational Psychology.** 2 to 4 hours. May be repeated. Supervised practicum in organizational settings, including industry and educational institutions. Prerequisite: Psch. 330.
435. **Practicum in Psychotherapy.** 4 hours. May be repeated for credit for a maximum of 8 hours. Supervised practice in a counseling or clinical setting. Application of basic principles; special emphasis on the problems of the culturally disadvantaged. Prerequisites: Psch. 430 and consent of the instructor.
436. **Personnel Measurement Techniques in Industry.** 4 hours. Development, analysis, and use of tests in the selection, classification, and performance evaluation of industrial personnel. Practice in the development and validation of industrial classification and selection of test batteries are included. Prerequisites: Psch. 332 or the equivalent and Psch. 345.
438. **Seminar in Organizational Psychology.** 4 hours. May be repeated. Review of current topics, which are announced each quarter. Prerequisite: Consent of the instructor.
439. **Research in Counseling and Psychotherapy.** 4 hours. Systematic review of special topics in individual treatment; emphasis on current research. Prerequisites: Psch. 430 and consent of the instructor.
441. **Survey Research Methods.** 4 hours. Same as Sociology 404. Methods of sampling human populations; interviewing techniques; techniques of analyzing survey data; the uses and limits of sample surveys in testing hypotheses; supervised participation in survey research. Prerequisite: Psch. 343 or the equivalent.
443. **Advanced Statistics II.** 4 hours. The Chi-square and F-distributions, analysis of variance, individual comparisons, regression, and correlation analysis. Prerequisite: Psch. 343 or the equivalent.
444. **Experimental Design and Analysis of Variance.** 4 hours. Analysis of variance and testing of hypotheses concerning contrasts in means in advanced experimental designs used in behavioral research. Prerequisite: Psch. 443 or the equivalent.
445. **Multivariate Analysis.** 4 hours. The statistical analysis of functional relationships among two or more variables; various forms of correlation analysis; introduction to discriminant and factor analysis. Prerequisite: Psch. 443 or the equivalent.



446. **Research Methods in Naturalistic Settings.** 2 hours. Problems associated with the collection and analysis of data in naturalistic settings, emphasizing unobtrusive measures and the logic of causal emphasis based on correlational procedures and quasi-experimental designs.
447. **Psychological Measurement.** 4 hours. Scaling theory and methodology; emphasis on measurement in psychophysics, differential psychology, and social psychology. Prerequisites: Psch. 343 and 315 or 356 or the equivalents.
449. **Seminar in Quantitative Methods in Psychology.** 2 hours. May be repeated. Systematic review of special topics; emphasis on current developments and applications. Prerequisite: Consent of the instructor.
450. **Special Topics in Physiological Psychology.** 4 hours. Review of theory and research in various areas of physiological psychology, such as perception, emotion, motivation, and learning; emphasis on neuroanatomical, neurophysiological, and neuropharmacological mechanisms underlying these behaviors. Prerequisite: Psch. 362.
451. **Techniques of Psychological Intervention.** 4 hours. May be repeated if instructor consents. Critical analysis of principles, techniques, and research in various types of psychological intervention. Each quarter the focus is on a different technique, such as behavior modification, psychotherapy, group therapy, play therapy, and community consultation. Prerequisite: Psch. 430.
456. **Discrimination Learning.** 4 hours. Generalization, simultaneous and successive discrimination, secondary reinforcement, and choice behavior are studied with respect to various theoretical predictions. Oral presentations on related topics are required. Prerequisite: Psch. 350.
470. **Theories of Learning.** 4 hours. Historical and methodological analysis of theoretical formulations of learning. Prerequisite: Psch. 350.
472. **Theories of Personality.** 4 hours. Contemporary theoretical formulations concerning personality and their evidential basis. Prerequisite: Psch. 350 or 352.
473. **Advanced Psychopathology.** 4 hours. A basic course for all graduate students in clinical psychology; a core course. Detailed consideration of disorders of behavior, including description, etiology, prognosis, and experimental and clinical research; development and function of classification systems. Prerequisite: Psch. 472.
479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology.** 2 hours. May be repeated. Same as History 479 and Philosophy 479. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.
480. **Behavior Disorders in Children.** 4 hours. Major types of maladjustment in childhood. Emphasis on the emotional, motivational, and intellectual difficulties of the culturally deprived. Prerequisite: Consent of the instructor.



482. **Psychological Appraisal I: Test Development, Intellectual Functions.** 4 hours. Theory of test development and test assessment. Theory, research, and techniques relating to the assessment of intellectual abilities. Training in the administration, scoring, and interpretation of standard test methods.
483. **Psychological Appraisal II: Intellectual Functions and Structured Tests.** 4 hours. Intelligence tests in clinical use. Theory and research relating to the development and use of structured tests for personality assessment. Training in the administration, scoring, and interpretation of structured tests. Prerequisite: Psych. 482 or the equivalent.
484. **Psychological Appraisal III: Projective Techniques.** 4 hours. Theory and research relating to the development and use of projective techniques for personality assessment. Training in the administration, scoring, and interpretation of projective techniques. Prerequisite: Psych. 483 or the equivalent.
485. **Practicum in Psychological Appraisal.** 4 hours. May be repeated. Supervised practice in psychodiagnostic testing in various facilities associated with the graduate training program in clinical and counseling psychology. Prerequisites: Concurrent registration in Psych. 482 or 484 and consent of the instructor.
487. **Practicum in Instruction in Psychology.** 8 to 12 hours. Supervised teaching of an undergraduate course and participation in a seminar dealing with techniques of course planning, teaching, and examining. Prerequisite: 6 hours of credit in Psych. 490.
488. **Seminar on Clinical Psychology.** 2 hours. Selected topics. Prerequisite: Consent of the instructor.
489. **Seminar in Advanced Psychodiagnostics.** 4 hours. Consideration of a series of children and adolescents with varied behavior and school problems who have been studied intensively with psychodiagnostic procedures and for whom extensive follow-up data are available. Appropriate readings; clinical report writing. Prerequisites: Psych. 484, 485, and consent of the instructor.
490. **Colloquium on the Teaching of Psychology.** 2 hours. Problems and methods of teaching at the college level. Group discussion techniques; task analysis; test construction and analysis; curricular materials. Prerequisite: Graduate standing in the department.
491. **Colloquium on Research in Psychology.** 2 hours. May be repeated for a total of 6 hours. Discussion and evaluation of individual research projects; directed training in conducting research in different areas of psychology and in developing skills related to this research.
495. **Individual Research.** 2 to 8 hours. May be repeated. Research on special problems not included in the graduate thesis. Prerequisite: Consent of the instructor.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Research on the topic of the graduate thesis. Prerequisites: Consent of the instructor; approval of the research prospectus by the thesis committee.

## THE JANE ADDAMS GRADUATE SCHOOL OF SOCIAL WORK

**Professors:** Mark P. Hale, Director; George W. Magner, Associate Director; W. Paul Simon, Mary Sullivan, Imogene Young, Sidney Zimbalist

**Associate Professors:** Claire M. Anderson, Eloise J. Cornelius, H. Frederick Brown, James Forkeotes, Joseph R. Godwin, Ord Matek, Harvey Treger, Samuel Weingarten, Narayan Viswanathan

**Assistant Professors:** Leona B. Cain, Lenora Cartright, Gloria J. Cunningham, John C. Dietmann, Frieda H. Engel, Joy Johnson, Kenneth Krause, Almera Lewis, Clarence Lipschutz, Ruth Meyer, Seymour Mirelowitz, Christopher G. Narcisse, Jeanore Parham, Sylvia Vedalakis, Hariette J. Watson, Dorothy R. Young

**Instructors:** James Collier, Rae Freed

The Jane Addams Graduate School of Social Work offers, on both the Chicago Circle and the Urbana campuses, a program of professional study leading to the Master of Social Work. While each campus offers concentrations in social treatment (direct practice), community organization and planning, and social welfare policy and services, there are some program differences; therefore, interested students should consult the School bulletins. There is presently an undergraduate social welfare major offered at Urbana; one is being developed at Chicago Circle.

The educational program of the Jane Addams School is designed to give the student the knowledge, skills, attitudes, and philosophy basic to all professional social work practice rather than merely to prepare him for positions in specific agencies. Within each of the concentrations, there are organized curriculum areas that include human growth and behavior, social work practice, welfare policy and services, and social research. At Chicago Circle most of the second year offerings are electives, allowing the student to pursue individual career interests. In both years an extensive field, or direct practice, experience is required.

In Chicago, field work is generally concurrent with class work, although several alternate models are being tested. The student will usually be placed in two distinct settings, with attention being paid to career interests and desired method of practice (casework, group work, community organization, etc.). There are a few instances where deference is given an agency from which a student holds a scholarship.

### Admission Requirements

A satisfactory undergraduate scholastic record, 20 hours in the social sciences, and evidence of personal suitability for the field are the basic

requirements. The minimum undergraduate grade-point average is 3.500 and only under unusual circumstances is consideration given an applicant with a grade-point average below 3.500.

Since the number of possible enrollments is limited and new students will be admitted only in the fall quarter, early application is advisable. Scholarships and fellowships are available through the School and through many public and private social agencies.

A bulletin about the School and application forms may be obtained by writing the Jane Addams Graduate School of Social Work at Chicago Circle, Box 4348, Chicago, Illinois 60680. A listing of agencies and field instructors is included in the School bulletin.

### **The Joint Program with McCormick Theological Seminary**

A special curriculum has been arranged in cooperation with the McCormick Theological Seminary in Chicago through which students may simultaneously complete requirements for the Master of Social Work (casework or group work) and the Bachelor of Divinity or Master of Arts in Christian Education or Master of Arts in Church and Community.

This program is for a limited number of students who plan to engage specifically in social services under religious auspices. It usually requires three years of graduate study at the Seminary and at the School of Social Work. Financial assistance is available. Applicants must be accepted by both institutions and must apply to both. Seminary applicants should address: Department of Church and Community, McCormick Theological Seminary, 2330 North Halsted Street, Chicago, Illinois 60614.

### **Degree Requirements for the Master of Social Work**

*Hours:* Candidates must successfully complete 96 quarter hours of graduate work (including work in each of the four general areas) with a cumulative grade-point average of 3.750. An average of 3.750 is required if a candidate is to remain in good standing. Those whose average falls below 3.750 in any quarter will be placed on probation and will be required to achieve a 3.750 minimum cumulative average by the end of the year.

*Residence:* A minimum of 36 quarter hours of resident credit is required; the candidate must carry a full program (12 quarter hours) at Chicago Circle for at least three consecutive quarters. A maximum of 48 hours of credit may be transferred for work taken elsewhere.

*Time Limit:* All requirements must be completed within six years. Military service is deducted. Exceptions may be made only in unusual



circumstances. Several plans have been developed for spreading the degree program over a three-year period with one year devoted to full-time work in residence.

## The Program at Chicago Circle

Much of the first-year program of the Jane Addams Graduate School of Social Work at Chicago Circle is mandatory and is comprised of those courses considered generic to all aspects of social work practice. Students who enter the School with a strong undergraduate social welfare background may, upon satisfactorily demonstrating the necessary knowledge base, have some of these requirements waived. These first-year courses generally will include: a social work method or a combination of methods, welfare policy and services, an overview of community organization practice, social work research, human growth and behavior (with a dual focus on ego psychology and social science theory), and field instruction. In the second year there is a great deal of flexibility, and a number of electives and alternatives are available in all three of the major concentrations.

## Courses for Graduate Students

Prospective students should note that the curriculum of the School of Social Work is undergoing extensive modification. Therefore, the following courses reflect only a portion of the total that are being developed. For example, in addition to the social treatment courses listed, there are a number of other electives: clinical diagnosis, crisis intervention, treatment with children, advanced group dynamics, treatment with adolescents, and others. In the foundation courses within Human Growth and Behavior are such electives as: human sexuality, drug abuse, majority and minority cultural interaction, the black experience, theories of personality, and theories of psychotherapy. There will also be available in the 1971-1972 academic year a number of courses within the newer concentrations—community organization and planning and social welfare policy and administration. Because many of these are still being processed they could not be included at the time of this printing.

## Courses for Graduate Students

401. **Social Casework I.** 2 to 4 hours. Analysis and study of the underlying philosophy, concepts, generic principles, and methods of social casework; role of the caseworker in offering service through a professional relationship.
402. **Social Casework II.** 2 to 4 hours. Continues development of social casework concepts and principles through analysis of case material from secondary settings.



Consideration of psychological and cultural factors which affect the treatment process. Analysis of the interconnectedness of relationship, study-diagnosis, and treatment phases of social casework. Prerequisite: SocW. 401.

403. **Social Casework III.** 2 to 4 hours. Continues Social Work 402. Emphasis on increased independent analysis of case material and use of relevant source material related to specific cases. Learning experiences are arranged to assist the student to acquire greater integration of philosophy, concepts, and principles in social casework. Prerequisite: SocW. 402.
404. **Social Casework IV.** 2 to 4 hours. Continues study of casework principles and methods. Emphasis on work with clients with complex emotional and personality problems, the stresses which impair social and ego functioning, and the effects of agency setting. Prerequisite: SocW. 403.
405. **Family Diagnosis and Treatment.** 3 hours. The evolution and definitions of family treatment; identification and examination of theories which add to the understanding of family diagnosis and treatment, application of selected theories and therapeutic methods to a variety of dysfunctional family situations. Use of family therapy in social work is stressed. Prerequisite: SocW. 403.
406. **Social Casework VI.** 2 to 4 hours. Casework theory and practice focused on multiple-client interviewing and family diagnosis and treatment. Current issues in casework theory and the changing role of the caseworker in a changing society are discussed. Prerequisite: SocW. 405.
407. **Consultation.** 2 to 4 hours. The knowledge and theory base of consultation; emphasis on the role of the social worker as a consultant. Examination of the several models of consultation and analysis of the characteristics and techniques of consultation in the various fields of social work practice. Prerequisites: SocW. 443 and 403 or 413.
411. **Social Group Work I.** 2 to 4 hours. Group-work methods, with focus on the worker's problems and procedures in understanding the group, its objectives, and its relationship to the agency. Beginning formulation of the worker's role in reference to assessment, interaction, analysis and small-group theory.
412. **Social Group Work II.** 2 to 4 hours. Further emphasis on group methods, with intensive application of understanding and working with individuals in the group and in the agency. Social work practice with groups, including relationship, use of program, and the helping processes. Prerequisite: SocW. 411.
413. **Social Group Work III.** 2 to 4 hours. The integration of concepts in the worker's role with the individual and the group; the referral processes. The worker's role as a strategy of intervention is developed. Prerequisite: SocW. 412.
414. **Social Group Work IV.** 2 to 4 hours. Advanced principles of social group work in direct service with the group, advanced group theory, and concepts of group stress and crisis situations. The development of criteria for analysis of the worker's role. Prerequisite: SocW. 413.

415. **Social Group Work V.** 2 to 4 hours. Further development of the concepts of the worker's role in direct service, with refinements illustrated from analysis of treatment groups in special settings. Work with individuals, family groups, and interdisciplinary elements in collaboration. Prerequisite: SocW. 414.
416. **Social Group Work VI.** 2 to 4 hours. The final course in the group-work sequence. Assists the student in the integration of method and analysis of his own practice. Emphasis is on the wider role of organizing and supervising group services. Selected concepts of subexecutive and supervisory functions are identified. Current issues and new modalities in social work with groups are developed. Prerequisite: SocW. 415.
419. **The Adolescent and His Family Group.** 3 hours. Designed to promote diagnostic understanding of the adolescent and the family group with which he lives. Developmental study of the growth of families, the impact of an adolescent on the family system, and impact of the family system on the adolescent. Both normal and abnormal development are considered. Prerequisites: SocW. 443 and an introductory course in group process.
421. **Combined Treatment Methods I.** 2 to 4 hours. Identification of components of social work practice, including underlying philosophy, concepts, generic principles, values, and methods of social casework and group work. Similarities and differences in the two primary social work treatment methods are considered. Emphasis on the social worker's role in offering service through a professional relationship in case and group situations. Prerequisite: Undergraduate degree or consent of the instructor.
422. **Combined Treatment Methods II.** 2 to 4 hours. Examination of social work practice theory through the development of different casework and group approaches. The worker's role is analyzed in terms of specific intervention strategies based on different theoretical orientations. A conceptual model framework is utilized to compare theories. Casework and group work models are analyzed separately and compared. Prerequisite: SocW. 421.
423. **Combined Treatment Methods III.** 2 to 4 hours. Integration and application of social casework and group work concepts to social work practice. Emphasis on the worker's activity in serving clients with different kinds of problems in different social work settings. Examination of generic and specific aspects of casework and group work practice. Prerequisite: SocW. 422.
425. **Community Organization.** 2 to 4 hours. Principles, concepts, and methods of community organization in social work at the neighborhood, local, state, national, and international levels.
431. **Field Instruction I.** 3 to 6 hours. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 401 or 411, which must precede or be taken concurrently.

432. **Field Instruction II. 2 to 6 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 402 or 412, which must precede or be taken concurrently.
433. **Field Instruction III. 3 to 6 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 403 or 413, which must precede or be taken concurrently.
434. **Field Instruction IV. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 404 or 414, which must precede or be taken concurrently.
435. **Field Instruction V. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 405 or 415, which must precede or be taken concurrently.
436. **Field Instruction VI. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 406 or 416, which must precede or be taken concurrently.
441. **Human Growth and Behavior I. 3 to 6 hours.** The major forces influencing the growth and behavior of the individual from birth through adolescence. Socio-cultural, familial, physical, emotional, and intellectual factors as they enhance or retard social functioning. The relevance of this content to the profession of social work is constantly considered.
442. **Human Growth and Behavior II. 3 to 6 hours.** The individual's growth and behavior from early through late adulthood. Considerations of the essential developmental tasks and central conflicts for each major life phase, with attention focused on differentiating kinds of knowledge about personality and social functioning. Prerequisite: SocW. 441.
443. **Human Growth and Behavior III. 3 to 6 hours.** The nature and dynamics of social processes as related to growth and behavior. Study is centered on various groups within society—the family, class, ethnic group, and caste—and on the manner in which they influence individual personality development. The process of interaction and the meaning of membership within small groups is studied. Consideration is given to role expectations and the dynamics of small-group membership, particularly in the family. Attention is focused on the continuous process of change in group life and its effect on behavior. Prerequisite: SocW. 442.
444. **Treatment Aspects of Rehabilitation. 2 to 4 hours.** Study and analysis of the impact of catastrophic illness, disease, and rehabilitation procedures on the individual and his family; emphasis on the role of the social worker. Prerequisite: SocW. 443.



445. **Human Growth and Behavior V.** 3 to 6 hours. Psychopathology, including neuroses, psychoses, character disorders, psychosomatic dysfunction, organic conditions, and mental retardation. Discussion of diagnosis and treatment methods, including psychotherapy, somatic and drug therapies, and social work. Prerequisite: SocW. 444.
446. **Analysis and Study of Problems of the Aging.** 3 hours. The physical, psychic, and economic aspects of aging with reference to the contribution of ego psychology and certain social science theories. The relevance of such study to the provision of social services to individuals and groups and the planning of comprehensive health services are stressed. Prerequisite: SocW. 443 or the consent of the instructor and the student's adviser.
451. **Community Problem Solving.** 3 hours. Introduction to the nature and scope of social work intervention at the community level. Analysis of distinctive characteristics of the community as the locus for various social systems; emphasis on their implications for practice. Appropriate methods of problem solving.
452. **Community Development.** 3 hours. Community development theory and practice are analyzed and evaluated with given practitioner roles, community resources, client systems, and other means of change and development as affected by a variety of social, cultural, political, economic, geographic, and historical considerations, both foreign and domestic. Emphasis on the conditions students are likely to encounter in actual practice. Prerequisite: SocW. 451.
453. **Community Planning.** 3 hours. A range of approaches to community planning; special emphasis on their application to the development and implementation of social welfare programs. Examination of various levels of planning together with their relationship to other planning professions. Professional skills included are technical data collection, political processes, grantmanship, citizen involvement, advocacy roles, and models for evaluation. Prerequisite: SocW. 451.
461. **Special Studies in Social Work I.** 2 to 6 hours. Independent or group study in areas of special interest; application of social work principles to special problems or settings.
471. **Social Services and Welfare Policy I.** 2 to 4 hours. The function, nature, and scope of the social welfare institution. Social services as a response to social, personal, and economic problems of people. Effects of economic and social growth and change on the welfare enterprise.
472. **Social Services and Welfare Policy II.** 2 to 4 hours. Social Work 472 and 473 will cover current provisions and alternatives for their solution in the social security and money assistance programs. Prerequisite: SocW. 471.
473. **Social Services and Welfare Policy III.** 2 to 4 hours. Continues Social Work 472. Prerequisite: SocW. 472.
474. **Social Services and Welfare Policy IV.** 2 to 4 hours. Current provisions and critical evaluation of welfare policy issues; alternatives for their solution in the social services for the aged, children, court wards, and the mentally and physically ill. Prerequisite: SocW. 473.



475. **Social Services and Welfare Policy V.** 2 to 4 hours. Continues Social Work 474. Prerequisite: SocW. 474.
476. **Administration in Social Work.** 2 to 4 hours. Principles, concepts, and processes in social work administration. Special emphasis on leadership, policy and decision making, planning, and program organization.
493. **Social Research I.** 2 to 4 hours. Objectives of social research, design of experiments, and measurement and methods of collecting data.
494. **Social Research II.** 2 to 4 hours. Continues Social Work 493. Design of questionnaires and schedules; methods of data analysis, including statistical hypothesis testing and applications of inferential techniques; interpretation of results; preparation of the report; review of selected studies. Prerequisite: SocW. 493.
495. **Social Research III.** 2 to 4 hours. Seminar and tutorial as an aid to developing the research problem to be followed in the second year. Prerequisite: SocW. 494.
496. **Research Project I.** 2 to 4 hours. Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 495.
497. **Research Project II.** 2 to 4 hours. Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 496.
498. **Research Project III.** 2 to 4 hours. Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 497.

## SOCIOLOGY

**Professors:** Robert L. Hall, Head of the Department; Robert E. Corley, Peter P. Klassen, Roger W. Little, George J. McCall, Mildred A. Schwartz, Ethel Shanas

**Associate Professors:** M.Rue Bucher, James T. Carey, William W. Erbe, John W.C. Johnstone, John W. Martin

**Assistant Professors:** Butler P. Crittenden, Kathleen Crittenden, Hazel S. Fisher, Edward P. Friedman, Gerald M. Swatez, Larry Tifft, Mary G. Wiley

The Department of Sociology offers work leading to the Master of Arts and the Doctor of Philosophy.

The program for the Master of Arts is in general sociology and aims to provide basic familiarity with the concepts, techniques, and substance of three broad subfields—social organization, social psychology, and demography and human ecology. The student's research for a thesis may be in a specialized area, such as medical sociology, urban sociology, or political sociology.

The program leading to the Doctor of Philosophy in Sociology has two aims: to provide each student with advanced knowledge in a specialized area of sociology and to train each student to plan, conduct, and report empirical research in sociology.

## Admission Requirements

*Grade-Point Average:* 4.000 (A=5.000) for the last two years of undergraduate work. A student whose average is between 3.750 and 4.000 may petition for consideration.

*Graduate Record Examination:* Satisfactory scores on the aptitude tests (verbal and quantitative). The advanced test in sociology is required as an aid in advising students, but it will not be a factor in admission.

Students without strong undergraduate preparation in sociology are encouraged to apply if they meet the above standards. They will be required to complete extra courses to make up deficiencies.

Students who have completed some graduate study elsewhere must, in addition to the above requirements, offer a grade-point average of 4.500 in previous graduate study. Training in logic, philosophy of science, mathematics, and statistics is strongly recommended for those who expect to pursue a graduate degree in sociology. Admission preference is given to students who have completed such training.

## Master of Arts

*Hours:* 48 quarter hours, including 12 hours in Sociology 400, 401, and 402, Theory and Method in Sociology, and 8 hours in seminars at the 400 level.

*Comprehensive Examination:* A candidate must satisfactorily complete a comprehensive examination.

## Doctor of Philosophy

In addition to satisfying the general requirements of the Graduate College, students must complete graduate courses, selected in consultation with the student's major adviser, totaling at least 144 quarter hours beyond the bachelor's or 96 quarter hours beyond the master's. These courses must include Sociology 400, 401, and 402 and may include 24 hours in courses outside of sociology if the student's adviser approves. Students must successfully complete a qualifying examination in general sociology, which is given at the discretion of the department, and a preliminary examination in the student's area of specialization. A Ph.D. candidate must present evidence

acceptable to the student's examining committee that he: (a) has had supervised experience in empirical research at least equivalent to 8 hours of credit in the department's research practicum courses (Sociology 404, 405, 406); (b) has had successful experience in the clear presentation of sociological materials to students and colleagues in the department pro-seminar or the equivalent to that available in Sociology 302.

*Thesis:* Candidates must prepare a dissertation based upon empirical research.

## Courses for Graduate and Advanced Undergraduate Students

303. **Sociological Statistics. 4 hours.** Introduction to statistical tests of sociological hypotheses; estimation procedures; selected statistical procedures commonly used in sociology. Prerequisite: Soc. 263.
315. **Advanced Social Psychology. 4 hours.** Same as Psychology 310. Critical analysis of empirical research on social perception, communication and influence, group structure, role analysis, and socialization processes. Individual projects are required. Prerequisites: Soc. 185 or Psych. 243, and 16 hours in sociology or psychology.
316. **Adult Socialization. 4 hours.** Socialization as a process of induction into new roles, which occurs throughout the life cycle; the process is analyzed both at a social-psychological and a social-systems level with illustrations from various settings, such as marriage and family, and illness, migration, and particularly socialization into occupations and professions. Prerequisite: 8 hours of sociology at the 200 or 300 level.
317. **Social Psychology of Theater. 4 hours.** Same as Speech and Theater 317. Compares social-psychological theories which are explicitly dramaturgical and theories of drama which are explicitly social. Considers dramatic works as social-psychological events. Prerequisite: Soc. 130 or Psych. 115.
318. **Sociology of Literature. 4 hours.** How literature is influenced and in turn influences social forces; effects of social class, political and economic factors, and religious, ethnic, and racial affiliations on literary works; attitudes of writers, relationships to publics, reward systems, and related matters. Prerequisites: 8 hours of upper-division sociology and 6 hours of literature (any department).
320. **Sociology of Mass Communications. 4 hours.** Sociological analysis of the mass media of communication; empirical studies of the impact of the media on American society and culture; impact of television on children; effects of the media upon attitudes and opinions; processes by which news is created and transmitted. Prerequisite: 4 hours of upper-division sociology, or Soc. 100 and Spch. 113.

325. **Age Groups and the Social Order.** 4 hours. The relation of age groups to social structure; the demographic, sociological, and social-psychological conditions affecting the salience of age as a basis of social organization; recent writings on adolescents and youth; the theory of subcultures as applied to youth groups; relations between generations; current directions in the study of youth groups, both conventional and deviant. Prerequisite: 4 hours of upper-division sociology.
341. **Social Stratification and Classes.** 4 hours. Nature and systems of differentiation and ranking in societies, emphasis on the class structure in the United States; life chances, prestige, status, power, and social mobility in the United States and other societies. Prerequisite: 8 hours of upper-division sociology.
343. **Sociology of Education.** 4 hours. The relationship of the educational system to the social structure, major emphasis on the role of education in an advanced technological society. Prerequisite: 8 hours of sociology.
344. **Industrial Sociology.** 4 hours. Analysis of industrial society and industrial institutions; the meaning of work and work relations and of the relationship between work and authority, with cross-cultural emphasis; sociological analysis of collective bargaining and of the impact of industrial and labor organizations on the community and on society. Prerequisite: 8 hours of sociology.
345. **The Sociology of the Family.** 4 hours. The family as a social institution; its origin, its nature of kinship, its development, and its prospects. Prerequisite: 8 hours of sociology.
346. **Sociology of Science.** 4 hours. Organization of the scientific enterprise; emergence of science as a social institution; interrelations with other institutions, such as government, religion, economy, and the arts. Science as a social phenomenon; regularities in scientific behavior; consideration of both historical and contemporary material. Prerequisite: 8 hours of sociology.
347. **Sociology of Complex Organizations.** 4 hours. Characteristics of business, government agencies, schools, hospitals, and other large-scale organizations, approaches used to study organizations, and theoretical and empirical analysis of organizational processes. Prerequisite: 8 hours of sociology.
348. **Military Institutions in American Society.** 4 hours. Analysis of military institutions as components of the larger society; recruitment and socialization processes, behavior patterns in military organizations, paramilitary groups, and patriotic societies. Prerequisite: 12 hours of sociology or political science.
349. **Sociology of Occupations and Professions.** 4 hours. Theoretical and empirical analysis of the occupational structure and occupational mobility processes in American and other industrial societies; patterns of recruitment and retention in occupations and professions. Prerequisite: Soc. 263.
351. **Medical Sociology.** 4 hours. Sociological contributions to medicine and public health; social organization and the organization of health services; the sociology of illness. Prerequisite: 8 hours of upper-division sociology.



361. **Social Gerontology: Old People in America.** 4 hours. The aged: demographic trends, economic status, physical and social needs, family relationships. Prerequisite: 8 hours of upper-division sociology.
365. **The Sociology of Politics.** 4 hours. Sociological interpretation of leadership, citizen participation, and the development of political organizations, using comparative materials from the United States and other countries. Prerequisite: 12 hours of sociology.
366. **Community Power Structure.** 4 hours. Analysis of the power structure of American communities; special emphasis on the relation between theoretical assumptions and research procedures in current community studies. Prerequisite: 12 hours of sociology.
371. **Population I.** 4 hours. Primarily for sociology majors and graduate students. The measurement and study of major trends and differentials in fertility, mortality, population growth, and age-sex composition in the United States and other countries. Emphasis on social and cultural determinants and consequences. Prerequisite: 12 hours of sociology, including Soc. 185 or the equivalent.
372. **Population II.** 4 hours. The measurement and study of major trends in migration, population composition, marriage and divorce in the United States and other countries; theories and policies regarding population growth in relation to resources; population forecasting. Prerequisite: Soc. 371.
373. **Human Ecology.** 4 hours. The relationship between man and the natural environment. Emphasis on importance of population patterns and human institutions in adaptation. Prerequisite: 12 hours of sociology, including Soc. 185 or the equivalent.
376. **Urban Sociology.** 4 hours. Review and analysis of recent research on urban areas, including their social organization, culture and subcultures, institutions, and contemporary problems. Prerequisites: Soc. 263 and 276.
381. **Topics in Social Change.** 4 hours. Intensive analysis of a specialized topic on processes of social change. Each topic is announced at the time the class is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the instructor.
385. **History of Sociological Theory.** 4 hours. The major theoretical systems that have developed in the field, beginning with the foundations in philosophical and scientific thought before Comte and proceeding to some of the contemporary representatives in the field. Prerequisite: Soc. 263 or 8 hours of sociology.
389. **Independent Study.** 2 to 12 hours. Supervised study projects for graduate students and honors undergraduates; may consist of extensive readings in specialized areas of sociology or empirical research; exclusive of credit given under Soc. 499. Prerequisites: Soc. 263, 20 hours of sociology, and the approval of the department.

390. **Strategies of Research Design and Analysis.** 4 hours. The nature of sociological research; formulation of researchable problems; alternative research designs and procedures of data collection and analysis. Prerequisite: Soc. 263.
393. **Topics in the Sociology of Education.** 4 hours. Intensive examination of a specialized topic, which is announced each time the course is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the instructor.

## Courses for Graduate Students

400. **Theory and Method in Sociology.** 4 hours. Detailed examination of middle-range theories, such as compliant behavior, status congruence, and intervening opportunities in migration; the means of bringing evidence to bear on them. Emphasis on the link between theoretical assertions and data. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Consent of the instructor.
401. **Theory and Method in Sociology.** 4 hours. Continues Sociology 400. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 400.
402. **Theory and Method in Sociology.** 4 hours. Continues Sociology 400 and 401. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 401.
403. **Advanced Statistics in Sociology.** 4 hours. Analysis of contingency tables; multiple and partial, linear and nonlinear correlation; analysis of variance. Prerequisite: Soc. 303.
404. **Survey Research Methods.** 4 hours. Same as Psychology 441. Methods of sampling human populations; interviewing techniques; techniques of analyzing survey data; uses and limits of sample surveys in testing hypotheses; supervised participation in survey research. Prerequisite: Soc. 403.
405. **Experimental Methods in Sociology.** 4 hours. Design and analysis of laboratory and field experiments on human groups and organizations; uses and limits of experiments in testing sociological hypotheses; supervised participation in experimental research. Prerequisite: Soc. 403.
411. **Small Groups: Structure and Process.** 4 hours. Same as Psychology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.
419. **Seminar: Social Psychology.** 2 to 6 hours. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.
441. **Social Organization.** 4 hours. Analysis of selected social institutions, such as the family, educational system, political structure, and others; development and

interrelationships of social institutions; function of various institutions in simple and complex societies. Prerequisite: Consent of the instructor.

- 459. **Seminar: Sociology of Medicine.** 2 to 6 hours. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.
- 469. **Seminar: Sociology of Politics.** 2 to 6 hours. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.
- 471. **Population Theory and Methods.** 4 hours. Critical examination of the nature and development of population theories; study of research techniques and application to problem areas. Prerequisite: Soc. 372.
- 476. **Sociology of Urban Life.** 4 hours. Demographic, ecological and social processes involved in the development of the urban community; emphasis on the effects of urban development on these processes and the organization of human life in the city. Prerequisite: Soc. 376.
- 490. **Colloquium on College Teaching of Sociology.** 4 hours. Sociological analysis of contemporary university teaching; specific information and techniques for the presentation of sociology at the college level. Prerequisite: One quarter of graduate study.
- 499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Students registering for thesis research will register for credit under this number.

## SPEECH AND THEATER

**Professors:** Donald H. Dickinson, R. Victor Harnack, Chester C. Long, Carl A. Pitt, Harry J. Skornia

**Associate Professors:** Katharine T. Loesch, Barbara S. Wood

**Assistant Professors:** Natalie S. Schmitt

The department offers courses of study leading to the Master of Arts in Speech and Theater, with specialization in communication and public address and in theater.

## Admission Requirements

Admission to the program requires a bachelor's degree from an accredited university. Students who apply for graduate status in speech must present the equivalent of 30 quarter hours of study in speech and theater and must have

achieved a grade-point average of 4.000 (A=5.000) for the last 90 quarter hours of their undergraduate work. Students who have fewer than the required 30 hours or have a grade-point average below 4.000 may petition for special consideration.

## Degree Requirements

A thesis and successful completion of a comprehensive examination are required for the degree. A minimum of 48 quarter hours, of which at least 16 hours are at the 400 level, must also be presented. Of these 48 hours, at least 36, including thesis credit (6 to 12 hours), must be in speech and theater; the remaining 12 must be either in speech or in approved courses in other departments.

## Courses for Graduate and Advanced Undergraduate Students

301. **Communication Analysis.** 4 hours. Descriptions, models, proposed dimensions, and statistical treatment of the communication process. Prerequisites: Spch. 112, 113, 201 or 202, and 210.
302. **Group Communication Theory.** 4 hours. Detailed analysis and observation of group processes from the viewpoint of modern information and field communication theory. Prerequisites: Spch. 111, 112, 113, 210, and 211.
303. **Theories of Language Performance.** 4 hours. Contemporary theories and related research in language performance, centering upon selected approaches to language acquisition and behavior; special emphasis on the psycholinguistic approach. Prerequisites: Spch. 112, 201 or 202, and 210 or the equivalent or sufficient language-linguistic background.
311. **American and British Public Address I.** 4 hours. Critical and historical study of American and British speakers and their speeches to 1850. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.
312. **American and British Public Address II.** 4 hours. Continues Speech and Theater 311. From 1850 to 1920. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.
313. **Contemporary Public Address.** 4 hours. Contemporary speechmaking; principal focus on issues relating to economics and government, World War II, postwar international problems, and civil rights. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.
315. **The Rhetoric of Free Speech.** 4 hours. The rhetorical processes employed by those speakers in the British House of Commons and in America who participated in the freedom of speech movements. Consideration is given to issues relating to the contemporary American scene. Prerequisites: Spch. 212 and PolS. 355.



317. **Social Psychology of Theater.** 4 hours. Same as Sociology 317. Compares social-psychological theories which are explicitly dramaturgical and theories of drama which are explicitly social. Considers dramatic works as social-psychological events. Prerequisite: Soc. 130 or Psch. 115.
321. **European Theater History I.** 4 hours. Historical survey of the theater and theater arts of ancient Greece and Rome, medieval Europe, the Italian Renaissance, and Elizabethan England. Prerequisites: Spch. 121 and at least 8 hours of credit chosen from Spch. 241, 251, 261, 262, 264, and 265.
322. **European Theater History II.** 4 hours. Historical survey of the theater and theater arts from the seventeenth century to modern times in Europe and England. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 251, 261, 262, 264, and 265.
324. **American Theater History I.** 4 hours. Development of the American theater from 1700 to 1914; historical trends and dramatic literature. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 261, 262, and 264.
325. **American Theater History II.** 4 hours. Development of the American theater from 1914 to the present; native and European influences in determining theatrical trends. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 261, 262, and 264.
328. **Play Production Prospectus.** 4 hours. Seminar; emphasizes the stage director's central function in creating an artistic concept for producing a play and coordinating all elements of performance in an aesthetic unity. Historical research of a recognized classic and preparation of a complete production book. Prerequisites: Spch. 251, 264, and 265.
329. **Theatrical Criticism.** 4 hours. Seminar in the study and practice of theatrical criticism, principally modern and contemporary criticism. Historical bases of critical judgment of play and performance; function and influence of the critic in establishing artistic standards and cultivating public taste. Preparation of criticisms of current productions. Prerequisites: Spch. 122, 123, 261, and 264.
331. **Mass Media Programming.** 4 hours. Mass media program types; objectives, methods, and effects; creative development of programs from conception to script. Prerequisites: Two courses in speech including Spch. 232.
333. **Mass Communications Seminar.** 4 hours. The nature of mass media in contemporary society. The legal and social responsibilities of mass media institutions in the United States and abroad. Prerequisites: Two courses in speech including Spch. 131.
334. **World Broadcasting.** 4 hours. The broadcast systems used by the nations of the world; alternative and "mixed" systems; international organizations, agreements, exchanges, and problems; broadcasts to and from other countries; implications of such new developments as satellites; mass and nonmass uses. Prerequisites: Spch. 113, 131, and 231.

351. **Scene Design and Lighting. 4 hours.** A lecture-laboratory approach to the role of stage lighting in scene design. Analysis of historical background and sources; special emphasis on such areas as theories, psychological and aesthetic factors, and lighting application techniques and equipment. Lectures, readings and practical problems. Prerequisite: Spch. 251.
354. **The Psychology of Language. 4 hours.** Same as Linguistics 354 and Psychology 354. Introductory survey of methods, theory, and research; acquaints students with the history and present status of psychology's interest in language behavior. Prerequisite: Spch. 303.
361. **Periods and Styles of Acting. 4 hours.** Concentration on premodern styles of acting from these periods: classical Greece, *commedia dell'arte*, Elizabethan, Restoration and the eighteenth century, nineteenth century melodrama, and naturalism. Prerequisite: Spch. 262.
371. **Advanced Study in Language. No credit.** Intensive study of language and speech activities of elementary school children; particular attention to those children labeled language disabled. Includes the study of language acquisition and applicable speech activities. Prerequisite: Baccalaureate degree from an accredited institution.
372. **Instructional Applications of Television and Radio. 4 hours.** Television and radio as instructional communications media; the design of instructional materials relating the communications requirements of subject matter to communications capabilities of television and radio; production, utilization, and evaluation of instructional television and radio presentations. Prerequisites: Spch. 131 and two courses chosen from Spch. 231, 232, 233.
397. **Proseminar in Speech and Theater. 4 hours.** Examination of research trends and methodologies appropriate to the area. Prerequisite: 30 hours of credit in speech and theater.

## Courses for Graduate Students

401. **Experimental Psycholinguistics. 4 hours.** Same as Linguistics 401 and Psychology 401. Intensive review of experimental laboratory studies concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature language user. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisites: Spch. 354 or the equivalent and consent of the instructor.
404. **Seminar in Speech and Language Behavior. 4 hours.** May be repeated for credit up to 12 hours. Speech and first-language development; speech and language differences and related communicative problems within and across subcultures; recent research in speech and language mechanisms. Prerequisite: Spch. 303.
407. **Seminar in Interpersonal Communication. 4 hours.** Studies of problem solving in dyadic and larger small group structures. Prerequisite: Spch. 302.

413. **Proseminar in Persuasion.** 4 hours. May be repeated for credit up to 12 hours. Examination of contemporary theory and research involving variables in the persuasive process. Prerequisites: Spch. 210, 213, and any one of Spch. 311, 312, 313, or 315.
421. **Seminar in Theater History.** 4 hours. Specialized study of selected aspects of the American theatrical scene. Prerequisites: Spch. 324 and 325.
422. **Theories of Theater.** 4 hours. Comparative study of the esthetics of theater. Nature of the theatrical experience. The function and status of theater in various cultures. Emphasis on modern theories. Prerequisites: At least three courses chosen from Spch. 321, 322, 324, 325, 328, and 329.
423. **Special Topics in Criticism.** 4 hours. May be repeated for credit. Seminar in theatrical criticism. Intensive analysis of an individual critic or school or critical history of an important play; preparation of original criticism, applying existing standards and developing the student's individual approach. Prerequisite: Spch. 329.
439. **Television and Society.** 4 hours. The performance of radio and television in terms of content, government and industry controls, social responsibility, economic bosses, and effects. Prerequisites: Spch. 131 and 8 hours chosen from Spch. 231, 232, 233, 239, 331, 333, 334.
451. **Theater Architecture and Production.** 4 hours. Seminar in esthetic and technical problems presented by the interrelation of theater, stage, audience, and play. Field study of types of Chicago theaters and stages. Prerequisites: Spch. 251 and 351.
468. **Physiological and Acoustic Phonetics.** 4 hours. Same as English 468. Theories of physiological phonetics. The acoustics of speech. Acoustic bases for analysis, descriptions, and classification of the sounds of languages. Prerequisite: Ling. 451.
469. **Topics in Phonology.** 4 hours. Same as English 469. Contemporary theories of phonology; the nature of sound systems of languages; methods of investigating and describing such systems. Prerequisite: Ling. 451.
495. **Problems of Teaching Speech.** 4 hours. Seminar in teaching methods and procedures. Prerequisite: Spch. 295.
498. **Independent Research.** 4 to 8 hours. May be repeated for credit up to a maximum of 8 hours. Department-approved research projects not included in thesis research. Prerequisite: Consent of the head of the department.
499. **Thesis Research.** 0 to 16 hours. May be repeated for credit up to a maximum of 16 hours. Students registering for thesis research will register under this number. Prerequisite: Consent of the head of the department.

# Additional Courses for Graduate Credit

## ACCOUNTING

### Courses for Graduate and Advanced Undergraduate Students

- 300. **Managerial Cost Accounting.** 4 hours. Analysis of costs for control, decision making, and planning; standards and budgets as a guide to measuring operating performance. Prerequisite: Actg. 302.
- 301. **Asset Valuation and Income Determination.** 4 hours. The development, applications, and limitations of accounting theory as related to the valuation of assets and measurements of income. Prerequisite: Actg. 102.
- 302. **Accounting for Entity Interest.** 4 hours. Accounting for rights of creditors, stockholders, and partners in a going concern; effects of expansion and contraction on equities; basic principles of fiduciary and fund accounting. Prerequisite: Actg. 301.
- 303. **Auditing.** 4 hours. The history, function, and theory of auditing; nature of the necessary evidence for the accountant's professional opinion concerning financial position and the results of enterprise operations; applications of statistical sampling; auditing computerized systems. Prerequisite: Actg. 302.
- 304. **Federal Income Tax.** 4 hours. Concepts of federal income tax; its effects on decisions of corporations, partnerships, individuals, and trusts. Prerequisite: Actg. 300.
- 305. **Planning and Control.** 4 hours. The budget as a formal plan of action; the effect of decision making, forecasting, and uncertainty on the determination of enterprise goals; guidance techniques for the accomplishment of the planned objectives of a firm. Prerequisite: Actg. 300.
- 306. **Readings and Advanced Problems.** 4 hours. Consolidated statements, foreign subsidiaries, insurance, estates, theory, general statements. Prerequisite: Actg. 302.
- 307. **Federal Income—Advanced.** 4 hours. Advanced development of the basic concepts discussed in Accounting 304. Tax factors affecting business decisions of corporations, partnerships, estates, and trusts; special problems in reorganizations, liquidations, and personal holding companies; the federal estate tax and gift tax. Prerequisite: Senior standing. For accounting majors: Actg. 304.

### Courses for Graduate Students

- 400. **Managerial Accounting I.** 4 hours. Basic concepts and tools of analysis necessary for the quantification, recording, and communication of financial events.



- 401. Managerial Accounting II. 4 hours.** Accounting methods applicable to the determination and analysis of financial data relevant to managerial decision problems. Topics include cost behavior, budgeting for planning and control, cost allocation, cost accounting systems, and capital budgeting. Prerequisite: Actg. 400.
- 402. Financial Accounting I. 4 hours.** Formulation of a conceptual model of accounting valuation and its implications for accounting practice; accounting valuation methods applied to assets and equities and their relationship to the conceptual model; concepts and criteria underlying income determination. Prerequisite: Actg. 401.
- 403. Financial Accounting II. 4 hours.** Accounting procedures applicable to the formation, expansion, and dissolution of different business entities, such as partnerships, corporations, trusts, and estates; emphasis on accounting for the corporate entity. Prerequisite: Actg. 402.
- 406. Financial Planning and Control. 4 hours.** The uses of financial information for decision making and control; the role of the accounting system and corporate controller in developing and refining the data necessary for cost control and managerial planning. Prerequisite: Actg. 401.

## ADMINISTRATION OF CRIMINAL JUSTICE

### Courses for Graduate and Advanced Undergraduate Students

- 313. Advanced Criminalistics Analysis Laboratory. 5 hours.** Continues Criminal Justice 211. Covers more advanced concepts of identification and individualization, including the examination of less frequently encountered physical evidence materials, and empirical data requirement for interpretation of examinations.
- 314. Forensic Instrument Laboratory I. 5 hours.** Theory and procedures of separation, purification, and identification of components of forensic interest; extension of concepts introduced in Administration of Criminal Justice 211 and 212. Various methods, such as chromatography, solvent systems, and electrophoresis, are discussed. Prerequisites: CrJ. 211 and 313.
- 315. Forensic Instrument Laboratory II. 5 hours.** Advanced instrumental analytical procedures applied to such substances of forensic interest as physiological fluids, polymeric compounds, and pharmaceuticals. Instruments treated may include pyrolysis GLC, UV-IR spectrometer, atomic absorption, and differential thermal analysis. Prerequisites: CrJ. 211 and 314.
- 335. Organized Crime in the United States. 4 hours.** The development of organized crime throughout history; detailed consideration of the political, social, and economic conditions involved in the appearance, spread, and expansion of organized crime in America. Prerequisites: CrJ. 101, 102, 231; Soc. 225, 276.
- 339. Institutional Treatment of Offenders. 4 hours.** The role of the custodial and correctional institutions in the treatment of the offender; philosophy of

administration and management of institutions; survey of historical development and current trends in jails and prisons. Prerequisites: CrJ. 101 and 102; Soc. 225 and 276.

340. **Criminal Self and Criminal Careers. 4 hours.** The development of criminal self-conceptions; social-psychological processes of group alienation; development of commitment and professionalization in the development of criminal careers. Selected case studies. Prerequisites: Soc. 100, CrJ. 231.
345. **Community Treatment of Offenders. 4 hours.** The history and development of program relating to community treatment of offenders; examination of the philosophies and programs dealing with the rehabilitation and reintegration of the offender into society. Prerequisites: CrJ. 101 and 102; Soc. 225 and 276.
350. **The Role of Law Enforcement in Community Relations. 4 hours.** Analysis of the relationship between law enforcement and the social structure of the community, including an examination of the significant problem areas involving minority elements, cultural and ethnic groups, power and social-elite, and political and social-action movements. Prerequisites: CrJ. 101 and 102; Soc. 225 and 276; PolS. 205.
351. **Criminal Law I: Substantive Criminal Law. 4 hours.** Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. General doctrines of criminal liability in the United States; classification of crimes as against persons, property, and the public welfare. Emphasis on the concept of governmental sanctions of the conduct of the individual. Prerequisites: CrJ. 101 and 102.
352. **Criminal Law II: Criminal Procedure. 4 hours.** Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. The criminal process. Legal problems associated with the investigation of crime, the acquisition of evidence, the commencement of a criminal proceeding, the prosecution and defense of charges, sentencing, and appeal. Principal concern is with the development of existing procedures and examination of current efforts for reform. Prerequisite: CrJ. 351.
353. **Criminal Law III: The Instrumentalities of Criminal Justice. 4 hours.** Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. Continues Criminal Justice 352. Examination of the agencies which play significant roles in the criminal process. Functions of the law enforcement agency, counsel, and the courts. Particular emphasis on the responsibilities and interrelationships of the agencies examined. Prerequisite: CrJ. 352.
354. **Evidence. 4 hours.** Rules of evidence as they apply to judicial proceedings and administrative hearings relative to the criminal process. Development of the underlying rationale of the rules. Emphasis on the relationship between methods of evidence collection and admissibility. Prerequisite: CrJ. 353.
360. **Industrial and Commercial Security Administration. 4 hours.** Theories and philosophy of the administration of industrial and commercial security functions;

survey of contemporary organization and management of security operations; application of law enforcement principles within private enterprise. Prerequisites: CrJ. 103, 258, and 259.

391. **Proseminar in Criminal Justice. 4 hours.** Study in depth of current issues, problems, and developments of serious concern within the field of the administration of criminal justice. Prerequisites: CrJ. 101, 102; Soc. 225, 276; PolS. 205.
398. **The Problem of Justice. 4 hours.** Same as Political Science 398. The premodern view of justice, such as Plato's or Aristotle's; the modern understanding of justice, such as Hobbes' or Locke's, which is the foundation of the modern political regime; Rousseau's seminal political thought on justice which is the basis of a variety of reforms and alternatives offered to Hobbes' and/or Locke's political regime. Prerequisite: Two courses in political science, including PolS. 151.
399. **Independent Study. 4 hours.** For administration of criminal justice majors only. Independent study and research under the direct supervision of a faculty member, on a subject or subjects not covered in the regular curriculum. Prerequisites: Consent of the instructor by preregistration in the Curriculum Office; Soc. 225, 276; PolS. 205; at least five criminal justice courses, including CrJ. 101 and 102.

## ARCHITECTURE

### Courses for Graduate and Advanced Undergraduate Students

301. **Architectural Design VII. 6 hours.** Comprehensive architectural problems. Prerequisite: Arch. 204.
302. **Architectural Design VIII. 6 hours.** Comprehensive architectural design problems. Prerequisite: Arch. 301.
309. **Architectural Design Thesis. 6, 9, or 12 hours.** May be repeated for a total of 18 hours. Individual problems in architectural design. Prerequisite: Arch. 301.
311. **Forensic Architecture. 3 hours.** Legal problems in architecture. Prerequisite: Fifth year standing.
312. **Computer Applications in Architecture. 3 hours.** The use of electronic computers in building design and construction. Prerequisite: Math. 194 or 195.
313. **Building Construction Systems. 6 hours.** Static and dynamic environmental control systems. Prerequisites: Arch. 204 and 215.
314. **Industrialized Building. 3 hours.** Prefabrication of building components. Prerequisite: Fifth year standing.
315. **Logistics of Building Construction. 3 hours.** Problems encountered in the logistics of building construction. Prerequisite: Fifth year standing.

- 316. **Environmental Control Systems.** 6 hours. Problems of color, illumination, heating and air conditioning systems, and acoustics. Prerequisite : Arch. 313.
- 319. **Building Technology Thesis.** 6, 9, or 12 hours. May be repeated for a total of 18 hours. Individual problems in building technology. Prerequisite: Arch. 313.
- 331. **Architecture Seminar.** 1 to 5 hours. May be repeated for a total of 15 hours. Current problems in architecture. Prerequisite: Fourth year standing.
- 332. **Architecture Reading Course.** 1 to 5 hours. May be repeated for a total of 15 hours. Individually planned readings on selected topics under supervision of a faculty member. Prior to registration the student should be advised by the instructor. Prerequisite: Fourth year standing.
- 339. **Architectural Humanities Thesis.** 12 hours. Individual problems in the architectural humanities. Prerequisite: 21 hours in the history of architecture.
- 343. **Professional Practice.** 3 hours. Problems related to the practice of architecture. Prerequisite: Fifth year standing.

## ART-DESIGN

### Courses for Graduate and Advanced Undergraduate Students

- 300. **Art and Design Synthesis.** 4 hours. May be repeated for credit. Individual-project course. Students develop projects that synthesize the experience of 200-level courses in the Department of Art. Emphasis is on interdisciplinary activities. Prerequisites: 40 hours of 200-level courses in the Department of Art and approval of the department.
- 301. **Industrial Design.** 4 to 16 hours. Design of physical systems based upon user behavior, technical resources, and environmental factors. Investigation of system failures and product dysfunctions at the man/machine, work space, and environmental levels. Projects are developed by the student through tutorial consultation with an assigned instructor. Prerequisites: AD 225 or graduate standing and approval of the department.
- 302. **Communications Design.** 4 to 16 hours. May be repeated for credit. A comprehensive project in the area of social communications. A total program or a series of related units for use in one or more communications media is developed by each student through tutorial consultation with an assigned instructor. Prerequisites: Completion of the communications design sequence and approval of the department.
- 305. **Plastic and Graphic Arts.** 4 to 16 hours. Individual projects in the plastic and graphic arts area are developed by each student through tutorial consultation with an assigned instructor; may involve supportive consultation in all areas of the department to permit breadth and invention in media and processes. Prerequisites: 25 hours of appropriate 200-level courses and approval of the department.



315. **Independent Studies.** 4 to 12 hours. May be repeated for credit. Independent study, under supervision of a staff member, in an area of design or plastic and graphic arts not covered in the regular curriculum. The course is offered at the request of the student and only at the discretion of the staff members concerned. Prerequisites: 30 hours of 200-level courses and approval of the department.
355. **Photography-Film Tutorial.** 4 to 16 hours. May be repeated for a total of 16 hours. Independent study course. Sustained projects in any area of film activity or still photography. Prerequisites: AD 265 or 275 and approval of the department.

## BIOENGINEERING—See Information Engineering.

## BUSINESS LAW

### Courses for Graduate and Advanced Undergraduate Students

310. **Managerial Jurisprudence.** 4 hours. Application of the legal function to business administration. Basic legal tools for business transactions and corporate operations; legal aspects of the major segments of business management.

## ECONOMICS

### Courses for Graduate and Advanced Undergraduate Students

320. **Macroeconomic Theory.** 4 hours. Principles of national income accounting, determination of aggregate income and employment, the monetary system in relation to income and employment, short-term income fluctuations, long-term income growth.
321. **Microeconomic Theory.** 4 hours. Operation of individual markets; market structure; theory of the firm; theory of production; demand theory; general equilibrium and welfare economics. Prerequisite: Fin. 340.
322. **Managerial Economics.** 4 hours. Application of economic theory to decision making in the business firm. Demand and cost analysis, including demand forecasts; price policy of the individual firm; capital budgeting; production analysis; uses of operations research methods. Prerequisite: Econ. 321.
323. **Business Conditions Analysis.** 4 hours. Application of economic theory to analysis of changes in aggregate income and employment; quantitative economic models and their uses in the prediction of aggregate and more refined levels of business activity. Prerequisite: Econ. 320.
324. **Economic History of the United States.** 4 hours. Growth of the American economy from colonial times to the present; special emphasis on the forces and factors contributing to this process. Prerequisites: Econ. 121 and 8 hours of social sciences.

325. **Economic History of Europe.** 4 hours. Evolution of the economic institutions of Europe, beginning with the origins of capitalism; the development of industry, commerce, transportation, finance, and labor. Prerequisites: Econ. 121 and 8 hours of social sciences.
326. **History of Economic Thought.** 4 hours. Examination of the evolution of positive and normative economics from the sixteenth to the nineteenth century. Prerequisites: Econ. 121 and 9 hours of social sciences.
327. **Comparative Economic Systems.** 4 hours. Description and analysis of the normative and positive characteristics of capitalism, fascism, democratic socialism, and communism. Prerequisites: Econ. 121 and 8 hours of social sciences.
328. **Government Finance.** 4 hours. Government finance at the federal, state, and local levels, including government expenditures; principles of taxation; fiscal policy; government borrowing and the national debt; intergovernmental fiscal relations. Prerequisite: Econ. 321.
329. **Industrial Organization.** 4 hours. The structure of markets; behavior of firms within the market environment; measures of industrial concentration; economics of scale; mergers and the merger movement; price discrimination and tie-in sales; monopoly and cartel arrangements; resale price maintenance; innovation and technological change. Prerequisite: Econ. 321.
330. **Government and Business.** 4 hours. The rationale and the mechanisms of the social control of business; the effects of government action in influencing the behavior of business firms; the procompetitive policy embodied in the Sherman Act and related legislation. Prerequisite: Econ. 321.
331. **Labor Economics.** 4 hours. Economic problems and issues of trade union organization and wage theory; job security, hours, working conditions, labor legislation, unemployment. Prerequisite: Econ. 320 or 321.
332. **Urban Economics.** 4 hours. Survey of economic problems of cities; the nature and function of cities; the demand for and supply of housing and urban land; the implications of location theory for the spatial pattern of cities; the impact of government programs. Prerequisites: Econ. 121 and 8 hours of social sciences.
333. **International Economics.** 4 hours. The balance of payments; fixed, flexible, and multiple exchange rates; the forward exchange market; the international trade multiplier; the transfer problem; capital flows; the law of comparative advantage; the gains from trade; tariffs and subsidies; the factor price equalization theorem; international economic communities. Prerequisite: Econ. 320 or 321.
334. **Economic Development.** 4 hours. Basic problems and characteristics of underdeveloped countries; classical, neoclassical, and modern contributions to the theory of development; major proposals for accelerating development; basic approaches to economic development; laissez-faire, interventionism; role and methods of planning; foreign aid; and economic integration. Prerequisite: Econ. 320 or 321.

335. **Econometrics. 4 hours.** Specification of economic models; measurement of variables; estimation of economic relationships and testing of economic hypotheses; single equation problems in estimation; introduction to simultaneous equation estimation. Prerequisites: Econ. 320 and 321.
336. **Introduction to Mathematical Economics. 4 hours.** Application of mathematics to theories of consumer and producer behavior, to the determination of prices in markets, and to growth and stability features of macroeconomic models. Prerequisites: Econ. 320, 321; Math. 110, 112.
398. **Independent Study in Economics. 2 to 5 hours.** May be repeated once for credit. For students who wish to do independent study in an area not covered by existing course offerings, or to explore in greater depth a problem or subject covered in a previously taken course. Prerequisites: 15 hours of 300- level economics courses and consent of both a faculty member and the head of the department.
399. **Special Topics in Economics. 4 hours.** Exploration of an area not covered in existing courses offerings, or study in greater depth or at a more advanced level, of a problem or subject that is covered in an existing course. Subject matter, and sometimes the prerequisite, will vary from quarter to quarter; prior to registration students should consult the department secretary for further information. Prerequisite: 15 hours of 300-level economics courses.

## Courses for Graduate Students

400. **Managerial Economics. 4 hours.** Economic analysis applied to business operations; theory of production and cost analysis; capital theory; pricing of products and factors. Prerequisites: Econ. 320, 321; Fin. 341.

## EDUCATION

### Courses for Graduate and Advanced Undergraduate Students

301. **Educational Policy in Urban America. 4 hours.** Same as Political Science 301. Examination of selected urban phenomena in relation to educational bureaucracies and school socialization processes. Emphasis on: historical investigation of strategies for protest and change employed by ghetto populations; conditions that fostered these strategies; responses of schools and other target institutions; social-philosophical analysis of ideologies supporting both protest and response. Prerequisites: One course in the social foundations of education or the equivalent and consent of the instructor.
320. **Social Development of Urban Children. 4 hours.** A basic course that covers the general principles of social learning and socialization during childhood and the factors common to urban children that illustrate and modify these principles. Classroom observation of children and interviewing is required. Prerequisite: Psch. 220, or the equivalent by consent of the instructor.



321. **Learning in the Urban Classroom.** 4 hours. Examination of psychological theories and principles of learning as they apply to the teaching-learning process; particular attention to the investigation of central concepts of the psychology of learning in the urban classroom. Prerequisites: Ed. 210 and 230 or the equivalents and consent of the instructor.
323. **Introduction to Early Childhood Education.** 6 hours. 4 hours class time; 6 hours per week in schools. Educational implications of major schools of thought concerning the nature and course of child development and learning; differential effectiveness of programs oriented to various theories; special emphasis on intervention programs designed for impoverished populations, including Head Start. Prerequisites: Psch. 101 and 220 or the equivalents and consent of the instructor.
330. **Curriculum, Instruction, and Evaluation in Urban Education I.** 4 hours. A laboratory-discussion course; emphasizes the changing role of education in urban society and the implications of changes on curriculum decision making, design, instruction, and evaluation. Prerequisites: Ed. 250 or graduate standing and consent of the instructor.
331. **Improving Learning Environments in Secondary Schools.** 4 hours. Development of the basic skills and the understanding necessary to bring about productive changes in a school system; the skills are developed in conjunction with that of a plan for improving a specific learning environment. The consequences of change in the school as a social system.
332. **Issues in Secondary Curriculum.** 4 hours. Analysis of selected issues; investigation of viewpoints in related literature; field investigations when pertinent. Specialists are invited.
370. **Field Work for Urban Education.** 8 hours. Time is shared between field work and classroom to enable students to become intimately aware of some of city life as it affects children and education. The different work sections are: (1) workers in a black community; (2) workers in a Latin or Indian community; (3) workers in a selected white ethnic community; (4) school administrators and counselors; (5) workers in human relations arenas. Prerequisites: Ed. 250 or graduate standing and consent of the instructor.
371. **Community Education Laboratories.** 5 hours. 3 hours class time; 10 to 14 hours per week in directed field work. Analysis of the colonialist nature of the educational enterprise and of the relationships among the educational controllers, the teacher, and the community, through reading, lecture, discussion, and field work. Consideration of techniques for altering professional accountability of teachers from the employing community to those people the teacher purports to help: students and community. Prerequisite: Consent of the instructor.
383. **Teaching English as a Second Language.** 4 hours. Same as English 383 and Linguistics 383. The methodology of teaching English to residents of the United States who do not speak the language, especially Spanish-Americans. A brief description of the structure of American English, methods of teaching each aspect of its structure, various teaching devices and aids, special problems that may arise, and an examination of various texts. Prerequisite: Ling. 315.



390. **Critique of Educational Literature, Research Design, and Methodology.** 4 hours. Individual projects are assigned. Introduction to educational research literature; analysis of research findings in urban education; research methods and design in education; current issues in research methodology. Each student formulates a researchable problem and designs a systematic study in his area of concentration. Prerequisites: Ed. 250 or graduate standing and consent of the instructor.

## Courses for Graduate Students

400. **Seminar in Educational Sociology.** 2 hours. Sociological survey of the urban educational institution in the contexts of its neighborhood and of the larger social order. The school is considered a community with its own social structure and culture interacting with a neighborhood with a differing social structure and culture. The interface between school and neighborhood is studied in detail. Prerequisites: Ed. 370 or the equivalent and consent of the instructor.
430. **Curriculum, Instruction, and Evaluation in Urban Education II.** 4 hours. Emphasizes dynamics of group decision making in developing curricula for community schools, producing instructional materials for a selected community, and evaluating effectiveness of the instructional materials. The different work sections are: (1) black ghetto community; (2) Spanish-speaking community; (3) other selected communities. Prerequisites: Ed. 330, 370, 490 or the equivalent, and consent of the instructor.
431. **Curriculum Theory and Technology.** 4 hours. Components of the curriculum system are analyzed through the study of curriculum theory. The technology of curriculum planning, implementing and evaluating local, state, and national curricula is explored. Prerequisites: Ed. 430 or the equivalent and consent of the instructor.
440. **Guidance in the Urban School: Principles and Functions.** 4 hours. Examination of the guidance process concerned with providing for the developmental needs of all pupils. The interrelated roles of teacher, counselor, and other staff members in fostering a climate where healthy personalities can develop; emphasis on the full use of school and community resources. Prerequisites: Ed. 370 and consent of the instructor.
441. **Student Appraisal Procedures in the Urban School.** 4 hours. Examination of some of the ways in which the teacher and counselor can assess child behavior and development. Nontesting methods and interpretation of selected achievement, aptitude, and interest tests at different educational levels. Emphasis on the understanding of cultural factors that may limit effective appraisal. Prerequisite: Ed. 440.
442. **The Counseling Process.** 4 hours. The nature, functions, and goals of counseling in an urban school or youth center. Selected theories, with applications for school and agency counseling, and related problems and issues. An introduction to counseling interaction is provided through role-playing and supervised interviews in which study skills and related educational problems are presented. Prerequisite: Ed. 441.

449. **Internship in Counseling Urban Youth.** 8 hours. Students are assigned to urban schools where they function as assistant counselors. Responsibilities may include tutorial counseling, testing and testing interpretation, conferences with staff members and parents, preparing educational and vocational materials, arranging occupational field trips, and developing working relations with community agencies and organizations. Prerequisite: Ed. 442.
450. **Foundations of School Administration.** 4 hours. Introductory course in urban school administration. Emphasis on the interdisciplinary study of both the theoretical and practical aspects of administration. Prerequisite: Consent of the instructor.
451. **Administration Problems in Urban Schools.** 4 hours. The school as a social institution and its role in the solution of contemporary social problems. Emphasis on community-school relationship and its effect on school administrators. Prerequisite: Ed. 450.
459. **Internship in School Administration.** 8 hours. For students enrolled in the master's program in school administration. Students are placed in schools and community agencies to obtain practical knowledge of some of the community-school relationships studied in Education 450 and 451. Prerequisite: Ed. 451.
462. **Teaching Reading to Black and Spanish-Speaking Inner-City Students.** 4 hours. Examination of effective methods and materials. Particular emphasis on the interference of nonstandard language systems and/or Spanish. Section A: teaching black students; Section B: teaching Spanish-speaking students. Prerequisite: Ed. 461 or Ling. 315.
497. **Individual Study.** 1 to 6 hours. Students design, implement, and analyze results of a researchable problem in their individual area of concentration. Completed study is reviewed by faculty and peer committees. Prerequisites: Ed. 390 or the equivalent and consent of the instructor.

## FINANCE

### Courses for Graduate and Advanced Undergraduate Students

340. **Money and Banking.** 4 hours. Monetary and banking systems. The Federal Reserve System; monetary theory; international monetary relations; monetary policy in the United States. Prerequisite: Econ. 121.
341. **Business Finance.** 4 hours. No credit for graduate students in the finance curriculum. Nature of business finance and its relation to economics, accounting, and law; legal nature and forms of business enterprise; capital, capitalization, and financial planning; financial analysis and interpretation; initial financing, refinancing; working capital; income administration, including dividend policies; expansion; internal and external financial and economic relationships of the firm. Prerequisites: Actg. 102 and Econ. 320.

342. **Investments. 4 hours.** Types and distinguishing features of securities, security markets, analysis of financial statements and principles of valuation, quality differences, selection of securities to meet varying personal and institutional objectives. Prerequisites: Fin. 340 and 341.
343. **Risk and Insurance. 4 hours.** Basic principles; applications in different areas (life and property insurance); management of risks in the firm (insurance versus self-insurance); social and economic significance of insurance in the economy. Prerequisites: Fin. 340 and 341.
344. **Investment Policy. 4 hours.** Varying strategies to meet diverse objectives; investments for individuals, business firms, banks, insurance companies, pension and profit-sharing funds; interrelation of investment policies and the economic environment. Prerequisites: Fin. 342 and Econ. 323.
345. **Problems in Business Finance. 4 hours.** Selected areas in advanced corporate finance, including short-term asset management; capital budgeting under certainty and uncertainty; capital structure and dividend policy and theory; valuation and risk; the structure of capital asset prices, and implications of that structure for financial policy of firms. Prerequisite: Fin. 341.

## FRENCH

### Courses for Graduate and Advanced Undergraduate Students

301. **Stylistics I: Prose. 4 hours.** Detailed analysis of the style of selected French authors; practice in advanced composition. Prerequisite: Fr. 211 or the equivalent.
302. **Stylistics II: Poetry. 4 hours.** Detailed analysis of the style of selected French authors; practice in advanced composition. Prerequisite: Fr. 222 or the equivalent.
311. **Short Prose Fiction. 4 hours.** French prose narrative forms, excluding the novel, from the Renaissance to the present. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
316. **French Poetry I. 4 hours.** Major poets from the fourteenth through the eighteenth centuries. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
321. **French Literature of the Middle Ages I. 4 hours.** From the origins to 1300. Texts in modern French: *chansons de geste*; courtly romances (Chrétien de Troyes, et al.); *Roman de Renard*, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
322. **French Literature of the Middle Ages II. 4 hours.** The fourteenth and fifteenth centuries. Texts in modern French: chroniclers; lyric poetry; religious and comic drama. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.



323. **History of the French Language. 4 hours.** From its origins to the present. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
332. **French Literature of the Sixteenth Century. 4 hours.** Major writers to be read in modern French: Marot, Sceve, Rabelais, Ronsard, Du Bellay, Montaigne, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
333. **The *Pleiade*. 4 hours.** Theory and practices of the *Pleiade* poets: Ronsard, Du Bellay, Belleau, Baif, Jodelle, Pontus de Tyard, Desportes, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
334. **Montaigne: His *Essais* and His Age. 4 hours.** Detailed study of Montaigne's life, thought, and times as reflected in the *Essais*. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
341. **Seventeenth Century French Prose Writers. 4 hours.** Reading and analysis of major prose writers: Descartes, Pascal, Bossuet, Mme. de Sevigne, La Bruyere, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
342. **Seventeenth Century French Theater. 4 hours.** Reading and analysis of major dramatists: Corneille, Moliere, and Racine. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
344. **Seventeenth Century French Poetry. 4 hours.** Reading and analysis of major poets: Malherbe, Baroque poets, La Fontaine, and Boileau. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
345. **The Seventeenth Century French Novel. 4 hours.** Reading and analysis of major novelists: d'Urfe, Sorel, Scarron, Cyrano, Mme. de Lafayette, *Les Lettres Portugaises*, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
351. **French Literature of the Eighteenth Century I. 4 hours.** Prose writers; reading and analysis of Lesage, Montesquieu, Diderot, Voltaire, Rousseau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
352. **French Literature of the Eighteenth Century II. 4 hours.** Reading and analysis of major dramatists: Crebillon, Voltaire, Marivaux, Diderot, Beaumarchais, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
353. **Literary and Intellectual Currents of the Eighteenth Century. 4 hours.** Reading and analysis of selected works tracing major literary and intellectual currents; Montesquieu, Voltaire, Rousseau, Diderot, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
354. **The French Novel of the Eighteenth Century. 4 hours.** Reading and analysis of selected novels of Prevost, Crebillon *films*, Voltaire, Diderot, Rousseau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.



359. **Preromanticism. 4 hours.** The Preromantic movement in France from 1761 to 1814. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
360. ***La Bataille Romantique*. 4 hours.** Manifestos, polemical writings, and major literary productions of the period. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
361. **French Romanticism I. 4 hours.** Reading and analysis of selected works tracing the main developments in the Romantic movement from 1815 to 1829; Hugo, Stendhal, Merimee, Lamartine, Vigny, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
362. **French Romanticism II. 4 hours.** Reading and analysis of selected works tracing the main developments of the Romantic movement after 1830; Nerval, Baudelaire, Sand, Musset, Hugo, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
363. **The French Novel of the Nineteenth Century I. 4 hours.** Reading and analysis of major novelists: Chateaubriand, Senancour, Mme. de Stael, Constant, Lamartine, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
364. **The French Novel of the Nineteenth Century II. 4 hours.** Reading and analysis of major novelists: Stendhal, Balzac, Merimee, George Sand, Flaubert, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
365. **The French Novel of the Nineteenth Century III. 4 hours.** Reading and analysis of major novelists: the Goncourt brothers, Zola, Maupassant, Loti, France, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
366. **French Poetry II. 4 hours.** Major poets of the nineteenth century; Lamartine, Hugo, Musset, Vigny, Gautier, Baudelaire, Verlaine, Rimbaud, Mallarme, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
368. **Modern French Drama I. 4 hours.** Major dramatists of the nineteenth and twentieth centuries; Hugo, Vigny, Musset, Dumas *fils*, Augier, Becque, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
369. **Modern French Drama II. 4 hours.** Continues French 368. Curel, Porto-Riche, Rostand, Claudel, Lenormand, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
370. **Modern French Drama III. 4 hours.** Continues French 368 and 369. Cocteau, Giraudoux, Anouilh, Sartre, Camus, Beckett, Ionesco, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
371. **French Poetry III. 4 hours.** Major poets of the twentieth century; Jammes, Jacob, Apollinaire, Valery, Eluard, Breton, Aragon, Perse, Michaux, Prevert, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

372. **The French Novel of the Twentieth Century I. 4 hours.** Reading and analysis of selected novels by Gide, Proust, Mauriac, Colette, Cocteau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
373. **The French Novel of the Twentieth Century II. 4 hours.** Reading and analysis of selected novels of Malraux, Aragon, Saint-Exupéry, Celine, Giraudoux, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
374. **The French Novel of the Twentieth Century III. 4 hours.** Reading and analysis of selected novels by Sartre, Camus, Robe-Grillet, Sarraute, Butor, and other contemporary novelists. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
379. **Introduction to Afro-French Literature. 4 hours.** Selected prose and poetry of sub-Saharan African Francophone literature. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.
381. **Introduction to Linguistics. 4 hours.** French phonology, morphology, syntax, and semantics in comparison with English. Prerequisites: Fr. 212, 222, 281 or the equivalents.
382. **Teachers Course. 4 hours.** Resources, classroom materials, standard practices, and problems in the teaching of French; practical application to actual classroom situations. Prerequisite: Fr. 381 or consent of the instructor.
399. **Seminar in Selected Topics. 4 hours.** May be repeated for credit. Specific movements, authors, or works. Topics are announced in the Timetable. Prerequisite: Senior standing and/or consent of the instructor.

## Courses for Graduate Students

403. *Explication de Textes. 4 hours.* Detailed critical and stylistic analysis of selected short pieces of French prose and poetry. Lectures, discussion, and student *explications*. Prerequisites: Fr. 313 and 314 or the equivalents.
404. **Modern French Phonetics and Phonology. 4 hours.** One hour per week in the language laboratory. Phonetic description and transcription. Training in diction and interpretation of literary texts. Phonetics as a teaching device. Prerequisites: Fr. 313 and 314 or the equivalents.
405. **The Teaching of College French. 0 hours.** Required of all graduate teaching assistants. Problems of teaching French at the college level; classroom procedures, and the preparation and grading of tests and final examinations. Prerequisite: Teaching Assistant in French.
406. **Introduction to Old French Philology: I Phonology. 4 hours.** Phonological development of the French language from classical and vulgar Latin.

415. *The Libertins in the Seventeenth and Eighteenth Centuries*. 4 hours. Intensive study of works not usually covered in courses on seventeenth and eighteenth century literature. Prerequisites: Fr. 323, 324, 325, and 326.
427. *Romantisme Social*. 4 hours. Development of Romantic thought after the Revolution of 1830. Social consciousness of Sand, Hugo, Lamartine, Musset, Vigny. Influence of Leroux and Lamennais.
430. *The Use of Greek Mythology in the Contemporary French Theater*. 4 hours. Greek tragic vision in the works of Cocteau, Giraudoux, and Anouilh. Prerequisites: Fr. 319 and 324 or the equivalents.
440. *Seminar for Master of Arts Candidates*. 4 hours. May be repeated for credit. Topics to be announced each quarter.
490. *Independent Study for Graduate Students*. 1 to 8 hours. May be repeated for credit up to a maximum of 8 hours. Prerequisite: Consent of the head of the department.
499. *Thesis Research*. 0 to 16 hours. May be repeated for credit. Prerequisite: Approval of the department.

## GEOGRAPHY

### Courses for Graduate and Advanced Undergraduate Students

303. *Principles of Climatology*. 4 hours. Climatology; macroclimatology and microclimatology; particular emphasis on fluxes of energy and mass at the interfaces between the earth's surface and the atmosphere. The environment and man, plants, and animals; special emphasis on urban microclimatological problems. Prerequisites: Geog. 101, 102, and 103.
306. *Fundamentals of Landform Analysis*. 3 hours. Theories of landform processes and techniques of analysis. Prerequisite: Geog. 101 or GeolS. 102.
311. *Geography of Population*. 4 hours. Broad treatment of the problems created by the changing distributions and numbers of the world's population. Emphasis on the relationships between population and resources; intensive study of the implications for both overpopulated and underpopulated areas of the world. Prerequisites: Geog. 190 and 210.
312. *Geography of Religions*. 4 hours. Systematic treatment of geographical manifestations of the major religious systems of the world. Special attention to the geographical origins and dispersal mechanisms of religious systems and to the manner in which man organizes his life within the framework of his belief. Intensive study of applications being made in the geographical inquiry of religious systems. Prerequisites: Geog. 190 and 210.
330. *Location Theory and Spatial Analysis*. 4 hours. Spatial analysis in relation to theories of location of economic activity and regional development. Theoretical

systems; development and derivation of locational patterns of agricultural, manufacturing, and tertiary activities. Prerequisites: Geog. 190 and one course chosen from Geog. 230, 231, 233, or 235; or Econ. 121 or Mktg. 360.

335. **Geographical Modeling of Transportation Systems. 4 hours.** Discussion of the principles of spatial interaction; emphasis on commodity flows and passenger movements, the practicality of network analysis, and the impact of transportation facilities on land use and regional development. Techniques include simulation and evaluation of existing transportation systems and solutions to theoretical transportation problems. Prerequisite: Geog. 235 or 383.
336. **Decision Making and Resource Management. 4 hours.** The nature of decision making schema in resource management; classifying problems according to elements that may enter into decisions in the management of natural resources. Emphasis on attitudes on environmental quality and human adjustment to natural hazard. Prerequisites: Geog. 190 and 236.
350. **Areal Organization of Urban Systems I. 4 hours.** Geographic aspects of intracity relationships. Topics include the city as a complex man-machine system, and areal patterns of urban growth and development within the context of cross-sectional and longitudinal models. Prerequisites: Geog. 251 or 330 or one course in the 260 series and one in the 360 series.
351. **Areal Organization of Urban Systems II. 4 hours.** Geographic aspects of intercity relationships. Topics include patterns of intercity flows and development, continuous and hierarchical ordering of urban places, measurement of areal alignments, and the theoretical implications of different types of areal patterns. Prerequisite: Geog. 350.
361. **Problems of the Humid Tropics. 4 hours.** Natural and human aspects of tropical areas; problems of the humid environment relating to landforms, land use, resources, economic and social phenomena and institutions; emphasis on the development potential of humid, tropical lands. Individual research projects are assigned. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 260 series or one course in the 350 series.
362. **Problems of Arid Regions. 4 hours.** Natural and human aspects of arid areas; problems of the environment relating to landforms, land use, resources, and economic and social phenomena and institutions; emphasis on the development potential of arid lands. Individual research projects are assigned. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 260 series or in the 350 series.
365. **Interregional Exchange Dynamics. 4 hours.** Spatial analysis of the economic, social, and political facts that have resulted from and in, human and commodity flows among regions; special attention to the important relationships resulting from regional differences. Prerequisites: Geog. 311 or 330 or 190 and either 230, 231, 233, or 235 or Econ. 121 or Soc. 271.



381. **Geographic Information Systems I. 3 hours.** Problems encountered in the gathering and use of geographic data and the structuring of research within the light of existing relevant theory, measurement systems capabilities, and recognized objectives of research activities. Topics include review of data sources, methods of measurement, sampling models, and problems of dealing with aggregated reporting units, records matching, and missing data. Prerequisites: Geog. 182, 190 (or Math. 117, or Soc. 185, or QM 272), one 12 hour introductory sequence, and one 8 hour systematic sequence.
382. **Geographic Information Systems II. 4 hours.** Application of inferential statistical techniques and probability models in geographic research. Topics include use of descriptive parameters in recognizing geographic relationships, tests of significance, and recognition of particular areal patterns. Prerequisite: Geog. 381.
383. **Geographic Information Systems III. 4 hours.** Problems encountered in the management and portrayal of geographic data. Topics include preparation of data for manual and machine processing, data condensation and characterization, observation indexing, and the preparation of graphic and tabular displays. Prerequisite: Geog. 382.
385. **Thematic Cartography. 4 hours.** Discussion and experiments involving graphic representation of real-world areal patterns; preservation of geodetic and information properties; information generalization and reconstruction; semiotic problems and communications capabilities of mapped informational displays. Prerequisites: Geog. 285 or 382 and consent of the instructor.
386. **Introduction to Areal Patterns. 4 hours.** The characteristics and evaluation of selected real-world patterns. Application of the concepts of randomness and interdependence to the problem of understanding certain of the physical and cultural processes affecting the arrangement of objects in the landscape. Prerequisites: Geog. 286 or 382 and consent of the instructor.
387. **Remote Sensing of the Environment. 4 hours.** Principles and practice in interpretation of aerial photographs, radar, and infrared imagery. Knowledge of elementary physics and geometry is recommended. Prerequisites: Geog. 287 and consent of the instructor.
391. **Review of Geographic Thought and Research Methods. 4 hours.** Introduction to the theory and techniques of geographic research; modern geographic philosophy; interpretative analysis of bibliographic sources and the preparation of a bibliography; preparation and evaluation of individual papers on selected topics. Prerequisites: Two 2-course systematic sequences, one upper-division research methods course, one 300-level urban or regional course, and consent of the instructor.
399. **Special Studies in Geography. 2 to 5 hours.** May be repeated twice for credit for a total of 10 hours. Readings and reports in selected fields chosen in consultation with the instructor. Prerequisite: Consent of the instructor.

## GREEK

## Courses for Graduate and Advanced Undergraduate Students

305. **Homer: *Iliad*. 4 hours.** Reading and translation of extensive selections from the poem. Introduction to Homeric scholarship. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
310. **Pindar. 4 hours.** Reading and analysis of selected *Odes*. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
315. **Aeschylus: *Agamemnon*. 4 hours.** Reading and analysis of the play; discussion of the use of myth. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
330. **Aristophanes. 4 hours.** Reading and translation of at least two plays. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
340. **Demosthenes. 4 hours.** Reading and analysis of two or more speeches; study of their historical background. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
350. **Plutarch. 4 hours.** Reading and interpretation of one or more of the *Moral Essays* or the *Lives*. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
360. **Plato: *The Republic*. 4 hours.** Reading and interpretation of selections; analysis of style and thought, and the development of some of the major arguments. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
365. **Aristotle: *Nicomachean Ethics*. 4 hours.** Reading and analysis of selections from several books. Sources and problems of Aristotle's ethical writings. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
370. **Thucydides. 4 hours.** Reading and translation of selections from Thucydides' history of the Peloponnesian War. Sources and problems of Greek historiography. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
380. **Hellenistic Poetry. 4 hours.** Reading and analysis of selections from 350 B.C. to 350 A.D. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
381. **Greek Literary Criticism. 4 hours.** Reading and translation of Aristotle's *Poetica* and selections from Longinus' *On the Sublime*. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.
382. **Greek Rhetoric. 4 hours.** Selected texts illustrative of the Greek contribution to the art of rhetoric; special attention to the *Rhetoric* of Aristotle. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

399. **Independent Reading. 1 to 4 hours.** May be repeated for credit. For Greek majors and graduate students. Independent study under faculty direction. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

## HISTORY OF ARCHITECTURE AND ART

### Courses for Graduate and Advanced Undergraduate Students

331. **Seminar in Architecture History. 4 hours.** Individual conferences on assigned papers are required. Selected problems in the history of architecture. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours from HAA 231 through 238.
332. **Readings in the History of Architecture. 4 hours.** Individual conferences on assigned papers are required. Individually planned readings on selected topics under the supervision of a faculty member. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours from HAA 231 through 238.
333. **Literature, Theory, and Criticism. 4 hours.** Individual conferences on assigned papers are required. Selected readings and discussion of significant writers on architecture. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours from HAA 231 through 238.
334. **Chicago Building. 4 hours.** Individual conferences on assigned papers are required. Architectural and technical history of Chicago's commercial buildings from 1871 to the present.
335. **Wright and His Contemporaries, 1890 to 1910. 4 hours.** Individual conferences on assigned papers are required. Frank Lloyd Wright's domestic buildings in the Chicago area and his relationship to other members of the "Prairie School" of midwest architecture. Lectures, discussions, and field trips. Prerequisite: 12 hours from HAA 231 through 238.
336. **Seminar: Adler and Sullivan. 4 hours.** Individual conferences on assigned papers are required. Critical study of Chicago's foremost architectural partnership: monuments, theories, and practice. Prerequisites: 12 hours from HAA 231 through 238 and HAA 334.
341. **Art of the Fifteenth Century in Florence. 4 hours.** Individual conferences on assigned papers are required. Stylistic and iconographic studies of the works of the major painters, sculptors, and architects. Florentine history and literature in their relation to the visual arts. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.
342. **Art of the High Renaissance. 4 hours.** Individual conferences on assigned papers are required. Art of the great Italian centers during the late fifteenth and early sixteenth centuries. Emphasis on Leonardo, Raphael, Bramante, Bellini, Giorgione, and Michelangelo. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.

343. **Italian Art from 1520 to 1600. 4 hours.** Individual conferences on assigned papers are required. Art of the sixteenth century; emphasis on painting and sculpture. Special attention is given to Correggio, Pontormo, Bronzino, Gianbologna, Michelangelo, Palladio, Titian, and Tintoretto. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.
361. **Proseminar in Modern Painting. 4 hours.** May be repeated for credit at the discretion of the department. Individual conferences on assigned papers are required. Selected examples; development and diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.
362. **Proseminar in Modern Sculpture. 4 hours.** May be repeated for credit at the discretion of the department. Individual conferences on assigned papers are required. Selected examples; development and diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.
363. **Contemporary Art. 4 hours.** Individual conferences on assigned papers are required. The most recent developments in contemporary art, its theories and production. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.
372. **Japanese Prints. 4 hours.** History from the fourteenth century to the present; emphasis on Ukiyoe Hanga of the seventeenth to nineteenth centuries. Prerequisite: HAA 272 or the equivalent.
390. **Art History Tutorial. 4 hours.** Individual conferences on assigned papers are required. Methodology and philosophies of art history; application to selected problems in the field. Readings, discussions, and reports concerning fundamental literature of art history. Prerequisite: 12 hours in history of architecture and art courses at the 200 and 300 levels.
391. **Special Studies in History of Art. 4 hours.** May be repeated for a total of 12 hours. Individual conferences on assigned papers are required. Discussions of special problems with attention to a major theme, period, or artist each quarter. Student reports are required. Prerequisite: 12 hours in history of architecture and art courses at the 200 and 300 levels.
392. **Readings in Art History. 4 hours.** May be repeated for credit at the discretion of the department. Individual conferences on assigned papers are required. Individually planned readings on selected topics under supervision of a faculty member. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours in history of architecture and art courses beyond the 100 level.



## LATIN

### Courses for Graduate and Advanced Undergraduate Students

301. *Corpus Caesarianum*. 4 hours. For advanced undergraduates, graduates, secondary teachers of Latin, and prospective teachers. Rapid reading of Latin prose, based on the *Corpus Caesarianum*; discussion of the linguistic, literary, social, and political aspects that contribute to the understanding of the texts read. Prerequisite: At least one year of Latin beyond Lat. 106.
340. *Lucretius*. 4 hours. Reading and interpretation of extensive selections from *De rerum natura*. Prerequisite: 4 hours credit in Latin at the 200-level or the equivalent.
348. *St. Augustine: The Confessions*. 4 hours. Study of the autobiographical portions of *The Confessions*. Prerequisite: Any 200-level course in Latin.
350. *Medieval Latin*. 4 hours. Literary and linguistic study of Latin texts originating between 350 and 1350 A.D. Prerequisites: Lat. 106 and 203 or the equivalents.
381. *Roman Literary Criticism*. 4 hours. The principal contributions of Latin writers to the study of literature. Prerequisite: At least 12 hours credit in Latin at the 200 level or the equivalent.
382. *Roman Rhetoric*. 4 hours. Required for all Latin majors. The contributions of writers in Latin to the study and practice of rhetoric. Prerequisite: At least 12 hours credit in Latin or the equivalent.
390. *The Teaching of Latin in the Secondary School*. 4 hours. Theory and practice in foreign language instruction as they apply specifically to teaching Latin at the secondary level; objectives of instruction in Latin, historical perspectives, texts and materials of instruction; preprofessional orientation. Prerequisite: At least 8 hours of credit in Latin at the 300 level or approval of the department.

## LINGUISTICS

### Courses for Graduate and Advanced Undergraduate Students

315. *Introduction to Linguistics*. 4 hours. Introduction to theories of the syntactic, morphological, and phonological analysis and description of language. Prerequisite: 12 hours in English.
354. *The Psychology of Language*. 4 hours. Same as Psychology 354 and Speech and Theater 354. Introductory survey of methods, theory, and research; acquaints students with the history and present status of psychology's interest in language behavior.
380. *Problems in Linguistic Analysis*. 4 hours. Same as Anthropology 380. Examination of the methods and techniques used in linguistics, with reference to actual language data; emphasis on anthropological applications. Prerequisite: Anth. 280 or Ling. 315.

383. **Teaching English as a Second Language. 4 hours.** Same as Education 383 and English 383. The methodology of teaching English to residents of the United States who do not speak the language, especially Spanish-Americans. A brief description of the structure of American English, methods of teaching each aspect of its structure, various teaching devices and aids, special problems that may arise, and an examination of various texts. Prerequisite: Ling. 315.
387. **The Structure of English. 4 hours.** Critical evaluation of traditional and structuralist grammatical descriptions; introduction to transformational grammatical studies; detailed survey of a transformational syntax of English; brief introduction to generative phonology and morphophonemic analysis of English, especially stress. Prerequisite: Engl. 301 or Ling. 315.

## Courses for Graduate Students

401. **Experimental Psycholinguistics. 4 hours.** Same as Psychology 401 and Speech and Theater 401. Intensive review of experimental laboratory studies concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature language user. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisite: Ling. 354.
427. **Developmental Psycholinguistics. 4 hours.** Same as Psychology 427. Theoretical formulation, research methods, and research findings in the area of language development. Biological foundations and environmental influences; disorders of language development. Prerequisite: Ling. 354.
451. **Phonetics and Phonemics. 4 hours.** Introduction to articulatory phonetics and phonemic analysis. Detailed treatment of English phonemics. Practice in transcription of utterances from English and other languages. Prerequisite: Credit or concurrent registration in Ling. 315.
452. **Applied English Linguistics I. 4 hours.** Applications of linguistic science to the teaching of English syntax and grammar. Prerequisite: Ling. 387.
453. **Applied English Linguistics II. 4 hours.** Applications of linguistic science to problems of style, rhetoric, and metrics. Emphasis on the literary implications of linguistic knowledge. Prerequisite: Ling. 387.
454. **Linguistics and Language Learning. 4 hours.** Applications of linguistic science to the teaching of foreign languages. Development of comparative descriptions.
455. **Introduction to Indo-European Studies. 4 hours.** History of Indo-European studies; dialects of Indo-European; methodology of comparative and historical linguistics and its application to the reconstruction of Proto-Indo-European; current theories and problems of Proto-Indo-European phonology, morphology, and syntax. Prerequisite: A reading knowledge of French or German.

460. **Comparative Linguistics. 4 hours.** Introduction to diachronic linguistics and historical methods.
461. **Linguistic Analysis. 4 hours.** Bases of grammatical analysis, including phonology, syntax, and morphophonemics. Prerequisite: Ling. 387.
462. **Field Methods in Linguistics. 4 hours.** Recording and analysis of a language by means of native information. Prerequisite: Ling. 451.
463. **Dialectology. 4 hours.** Description and mapping of dialects, both synchronically and diachronically. Methods of dialect geography. Prerequisite: Ling. 451.
464. **Lexicography. 4 hours.** Survey and critical evaluation of current methods and procedures in dictionary writing; practical applications.
465. **History of Linguistic Science. 4 hours.** Development of linguistic thought from its historical beginnings to the present. Prerequisite: Ling. 315.
466. **Morphology. 4 hours.** Introduction to the principles of morphological theory, including word formation. Consideration of the various possible approaches to morphological analysis and the historical evolution of the concept. Prerequisites: Ling. 315 and 451.
467. **Syntax. 4 hours.** Introduction to the methods of syntactic analysis as applied to English and other languages, both Indo-European and non-Indo-European. Prerequisite: Ling. 466.
468. **Physiological and Acoustic Phonetics. 4 hours.** Same as Speech and Theater 468. Theories of physiological phonetics. The acoustics of speech. Acoustic bases for analysis, description, and classification of the sounds of languages. Prerequisite: Ling. 451.
469. **Topics in Phonology. 4 hours.** Same as Speech and Theater 469. Contemporary theories of phonology: the nature of sound systems of languages; methods of investigating and describing such systems. Prerequisite: Ling. 451.
470. **Language Typology. 4 hours.** Introduction to the history and methods of language typology from the nineteenth-century German Romantic philosophy (Wilhelm von Humboldt) through the early Indo-Europeanists and Edward Sapir to Greenberg's quantitative approach. Syntactic, lexicographic, and semantic typologies explored in addition to the traditional phonological and morphological ones. Prerequisites: Ling. 315 and 387 or the equivalents.
471. **Semantics. 4 hours.** Introduction to the history and methods of semantics from the nineteenth-century French positivist Michel Breal through the works of Wittgenstein, Bertrand Russell, and Korzibsky, to modern works of Roger and Brown, Ulman, Wells, Weinreich, Lyons, Ziff, Katz and Fodor, and Lamb. The different schools of semantic analysis are discussed and evaluated. Prerequisites: Ling. 301 or the equivalent and Ling. 315.

475. **Introduction to Computational Linguistics. 4 hours.** Introduction to the aims and methods of computer-aided linguistic analysis. Explanation of the basic workings of a computer; discussion of the nature of computer languages. Investigation of the ways a computer can be used to solve linguistic problems in the areas of phonology, morphology, syntax, translation, and lexicostatistics. Will include some actual work with the computer. No programming experience is required. Prerequisite: Ling. 315 or the equivalent.
476. **Contemporary Movements in Linguistic Theory I: Advanced Structuralism and Tagmemics. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of structuralism and tagmemics. Prerequisites: Ling. 465 and 467.
477. **Contemporary Movements in Linguistic Theory II: Advanced Transformational-Generative Grammar. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of transformational-generative grammar. Prerequisite: Ling. 476.
478. **Contemporary Movements in Linguistic Theory III: Advanced Glossematics and Stratificational Grammar. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of glossematics and stratificational grammar. Prerequisite: Ling. 477.
480. **Seminar in Sociolinguistics. 4 hours.** Same as Anthropology 480. Past and current approaches to sociolinguistics; variations of linguistic structure with social structure among different linguistic groups. Prerequisite: Ling. 380.

## MANAGEMENT

### Courses for Graduate and Advanced Undergraduate Students

330. **Organizational Psychology. 4 hours.** Same as Psychology 330. Individual psychological and group processes and their interaction with organizational structure. Behavioral factors in effective organizational change. Prerequisites: Psch. 230 and one course in social psychology or the equivalents.
333. **Motivation and Morale in Industry. 4 hours.** Same as Psychology 333. Concepts and methods in the assessment and modification of employee motivation, attitudes, and morale. Prerequisite: 12 hours of psychology, including Psch. 332 or the equivalent.
335. **Psychology of Industrial Training. 4 hours.** Same as Psychology 335. Psychological measurement techniques in assessing training needs and evaluating training effectiveness. Application of psychological techniques to the development of industrial training programs. Prerequisite: Psch. 332 or the equivalent.
338. **Psychology of Industrial Conflict. 4 hours.** Same as Psychology 338. Behavioral analysis of the causes, dimensions, and modes of resolution of industrial conflict; special emphasis on labor-management relations. Prerequisite: Psch. 330 or the equivalent.



350. **Organization and Administration. 4 hours.** Theories of management; concepts of organization; major functions of management; fundamentals of decision making. Emphasis on the role of management and administration within the business firm. Prerequisite: QM 272.
351. **Organization Theory. 4 hours.** Important theories of organization; their foundation, application, and consequences in the attainment of individual and organization objectives. Emphasis on formal and informal aspects of organizations, authority relationships, and structural aspects. Prerequisite: Mgmt. 350.
352. **Administration Practices. 4 hours.** Examination of executive and manager behavior in working organizations. Analysis of human problems and relationships at work. Leadership styles, problems of motivation and attitudes. Emphasis on behavioral science theory and technology as applied to business. Case method of analysis and study. Prerequisite: Mgmt. 351.
353. **Personnel Management. 4 hours.** The foundation, history, and objectives of manpower management; motivation and supervision; selection, training, and discipline; union-management relations; wage-and-salary administration; personnel research. Prerequisite: Mgmt. 350.
354. **Industrial Relations Systems. 4 hours.** Analysis of labor unions and their impact on business firms and society. Types of labor-management relationships and collective bargaining practices. Examination of public policy, union structure, and bargaining theory. Prerequisite: Mgmt. 353 or the equivalent.
355. **Operations and Systems Management I. 4 hours.** Application of management sciences to planning and design of operational systems. Emphasis on strategic planning, selection of objectives, use of technological forecasts, responses to technological change and systems controls. Prerequisite: QM 272 or the equivalent.
356. **Operations and Systems Management II. 4 hours.** Application of managerial sciences to operations and control of operational systems. Emphasis on systems operations facilities, systems standards and information flow, system maintenance, and the behavioral interface and system control. Prerequisite: Mgmt. 255 or the equivalent.
357. **Operations and Systems Management III. 4 hours.** Emerging concepts in management science. Managerial applications of computer technology and utilization and related electronic data processing. Applications of quantitative methods to information and control methods and systems. Process and systems design. Prerequisite: Mgmt. 356.
358. **Managerial Logistics. 4 hours.** The management of all activities governing the physical flow of raw materials and finished goods through stages of production on to points of final consumption. Key areas considered include design of logistics systems, location theory, inventory control, and the use of mathematical techniques in solving problems of logistics management. A logistics system computer simulation game is used. Prerequisites: Mgmt. 351 and Econ. 321.

359. **Business Policy. 4 hours.** A capstone course that provides an understanding of the direction of business operations from the top-management point of view, rather than from the limited view of a particular functional-area specialist. By means of class discussion, written analysis of cases, and development of feasible plans of action, students gain experience in determining problem areas in company planning and management and in dealing successfully with a constantly changing business environment. Prerequisite: Completion of core requirements of the College of Business Administration.
360. **Business, Society, and Technology. 4 hours.** Business and the corporate role in a complex, technological society. Emphasis on the historical evolution of business; the many relationships of the corporation to its external environment; urban problems of business; the impact of the corporation on individual and group behavior. Prerequisites: Econ. 322 or 323; Mgmt. 351.
363. **Collective Bargaining. 4 hours.** Intensive examination of the structure and conduct of collective bargaining: the determination of the bargaining unit and bargaining representative; the negotiation and scope of contracts; the administration of contracts; the major substantive issues in negotiations; the procedures for resolving industrial conflict. Prerequisites: Mgmt. 353 and 354.
364. **Labor Law and National Labor Policy. 4 hours.** The evolution of national labor policy considered within a framework of labor legislation, court decisions, and administrative rules. Problems of effectuating labor agreements; problems of protecting individual employee rights in a collective bargaining context. Introduction to the legal and constitutional problems of government regulation of industrial and labor relations. Prerequisite: Mgmt. 354.
366. **Technological Forecasting. 4 hours.** The methodology of forecasting the impact of technological change on the managerial process; emphasis on selection of goals and parameters, relevance of figures of merit and various forecasting methodologies. Prerequisite: Mgmt. 355 or the equivalent.
367. **Impact of Technological Change. 4 hours.** The impact of technological change on the business environment and the managerial process; emphasis on alternative futures and planning to attain desired ends. Prerequisite: Mgmt. 366.
373. **Collective Bargaining in Public Employment. 4 hours.** Practices and legislation pertaining to union-management relations at the federal, state, and local levels of government. Procedural and policy issues confronting public employees, union officials, and government administrators. Prerequisite: Mgmt. 354.
374. **Comparative Industrial Relations Systems. 4 hours.** Analysis of industrial relations structures, problems, and experiences among selected countries. Common and contrasting features of industrial relations systems are related to national economic, political, and social characteristics. Examination of the implication for management and economic development of differences among industrial relations systems. Prerequisite: Mgmt. 354.
399. **Independent Study. 2 to 4 hours.** May be repeated once for credit. Students in the College of Business Administration may register for this course to pursue

advanced independent study in approved topics related to management. A written report prepared under the guidance of a major professor is required. Prerequisites: 16 hours of upper-division management courses and consent of the department head.

## Courses for Graduate Students

451. **Organization Theory. 4 hours.** Classical and modern theories of organization. Organization structure and processes, line and staff relationships, management controls, managerial decision making, organizational objectives and restraints, management functions, formal and informal organization, bureaucracy, and behavioral science concepts. Prerequisite: Mgmt. 350.
452. **Administrative Practices. 4 hours.** Analysis of human problems in management and organization. Dynamics of leadership in the working organization, group dynamics, administrative behavioral patterns, administrative implications of decision making and policy formulation, and other relevant behavioral science concepts. Prerequisite: Mgmt. 451.
453. **Personnel Management. 4 hours.** Manpower management programs and policies. Staffing, training and development, historical evolution of personnel policies, modern labor force and technological trends, supervision, wage and salary administration, and manpower research and utilization. Prerequisites: Mgmt. 250 or the equivalent, and 451.
455. **Operations and Systems Management. 4 hours.** Basic principles and procedures for effective utilization of productive factors in a working organization. Facilities design, control systems, data processing, scheduling, automation, statistical analysis, computer technology, production planning, process design, and other relevant management science concepts. Prerequisites: QM 470 and 471.
457. **Seminar in International Business. 4 hours.** Management practices and problems in major nations. Legal and cultural factors affecting managerial policies and decisions; organization planning and manpower utilization, comparative management systems and ideologies. Prerequisite: Mgmt. 451.
458. **Seminar in Business Policy and Decision Theory. 4 hours.** To be taken in the final quarter of the student's degree program. A capstone course to integrate all the functional areas of business: policy formulation and administration, policy and decision implementation, long-range planning, control techniques, factor analysis and decision making, theories of decision making in an uncertain environment, quantitative techniques, simulation and case exercises, and study of actual business forms.
459. **Business and Society. 4 hours.** Historical background of American business systems and institutions; conflicts between business and economic groups; problems of social groups seeking specified goals in a pluralistic society. Prerequisite: Mgmt. 350.



## MARKETING

### Courses for Graduate and Advanced Undergraduate Students

360. **Principles of Marketing. 4 hours.** Required of all students in the College of Business Administration. The workings of the marketing system and the way in which marketing decisions are made.
361. **Consumer Market Behavior. 4 hours.** Motivations underlying market behavior of consumers, producers, middlemen; drives, emotions, desires, learning, memory; effects of demographic characteristics, social status, and reference groups on marketing action. Prerequisite: Mktg. 360.
362. **Marketing Research. 4 hours.** Investigation of the gathering and interpretation of information used in solving marketing problems; pertinent modern research techniques from mathematics and the behavioral sciences are employed in developing an analytical structure. Prerequisites: Mktg. 361 and QM 172 or the equivalents.
363. **Marketing Organization. 4 hours.** Principles underlying the development of an integrated distribution system; its relationship to the marketing structure of the firm; evaluation of decisions on raw-material sources, plant and warehouse location, wholesale and retail outlets; analysis of the movement of products through marketing channels. Prerequisite: Mktg. 362.
364. **Managing Marketing Communications. 4 hours.** Analysis of communication information among producers, middlemen, and consumers for marketing purposes; managerial problems in directing a firm's promotional efforts; personal selling, advertising, sales promotion, public relations. Prerequisite: Mktg. 363.
365. **Marketing Management. 4 hours.** Seminar. Building marketing programs to implement the achievement of marketing objectives. Individual and group research and presentation from the viewpoint of major marketing executives of the firm; business case analysis. Prerequisite: Mktg. 364.
366. **Comparative Marketing Systems. 4 hours.** An advanced course that treats domestic marketing systems and their structures and processes in a framework of comparative cultural, political, economic, and social systems. Prerequisite: Mktg. 360.
399. **Special Topics in Marketing. 4 hours.** Intensive study of selected problems. Reading assignments are drawn from scholarly and professional journals; emphasis on covering relatively few areas in great depth.

### Courses for Graduate Students

400. **Principles of Marketing. 4 hours.** Theory and practice in the formulation of marketing decisions; planning, pricing, and promotion; distribution of goods and services to all types of consumers.



- 460. Marketing Management. 4 hours.** The structural system for the management of marketing; environmental considerations; goal determination; the sequential process; marketing planning; product-market integration; channel components; demand stimulation; evaluation and audit. Prerequisite: Mktg. 400.
- 461. Consumer Behavior. 4 hours.** Application of knowledge from the behavioral sciences to the study of consumer behavior. Individual, group, and cultural influences on consumer preferences and purchasing patterns. Emphasis on both theory and application; examination of the advantages and limitations of this approach to consumer behavior. Prerequisite: Mktg. 460.
- 463. Information for Marketing Decisions. 4 hours.** Problem definition and the selection of appropriate research techniques for the solution of specific marketing problems; design of the research project, administration of research, and special problems in marketing research. The establishment and administration of information systems to provide the firm with a systematic, continuing appraisal of its market position. Prerequisite: Mktg. 461.
- 465. Marketing Communication and Promotional Strategy. 4 hours.** The ways in which a firm uses advertising, public relations, sales promotion, and personal selling to communicate with its customers. The functional characteristics of each of these is assessed in terms of varying marketing situations in the process of formulating the firm's strategy. Prerequisite: Mktg. 463.

## MUSIC

### Courses for Graduate and Advanced Undergraduate Students

- 300. Sixteenth Century Counterpoint. 3 hours.** Late Renaissance music. Analysis of representative scores and written assignments in sixteenth century contrapuntal style. Prerequisites: Mus. 203 and 206 or approval of the department.
- 301. Eighteenth Century Counterpoint. 3 hours.** Middle-to-late Baroque music. Analysis of representative scores and written assignments in eighteenth century contrapuntal style. Prerequisite: Mus. 300 or approval of the department.
- 302. Form and Analysis. 3 hours.** The melodic, rhythmic, harmonic, and structural analytic procedures of traditional musical form. Analysis of representative scores from the eighteenth to the twentieth centuries. Prerequisite: Mus. 301.
- 303. Compositional Techniques of the Twentieth Century. 4 hours.** European and American twentieth century music. Analysis of representative scores and written assignments in composition in one or more of the several contemporary idioms. Prerequisite: Mus. 302.
- 320. Proseminar in Music. 2 to 4 hours.** May be repeated for credit for a maximum of 12 hours. Selected topics for intensive study in specialized areas of musicology or music theory.

330. **Music as Experience. 4 hours.** The musical experience as found in the writings of theorists, composers, musicians, historians, critics, and philosophers. Prerequisites: Mus. 130 and one 200-level course in music.

## PHYSICAL EDUCATION

### Courses for Graduate and Advanced Undergraduate Students

300. **Administrative Theory and Practice in Physical Education. 4 hours.** A theoretical approach to the development of administrative thought as it relates to physical education; emphasis on the understanding of concepts and models from the social sciences and their implications for leadership in the educational setting; development of a personal philosophy of administration. Prerequisite: PEM 260 or PEW 250.
301. **Evaluation in Physical Education. 4 hours.** The availability and value of evaluative tools in physical education; methods for administration of evaluative techniques; analysis of interpretation and use of the results from evaluative techniques; description of the construction of new evaluative instruments employed in physical education. Prerequisite: PEM 253 or PEW 205.
302. **Synthesis of Human Movement Concepts. 4 hours.** Integration of selected concepts from biomechanics, exercise physiology, psychology, and sociology as they apply to the development of meaningful human movement. Prerequisite: Consent of the instructor.
303. **Instructional Techniques in Physical Education. 4 hours.** Theory and practice; special emphasis on the application of motor learning research to instructional techniques and teaching styles. Prerequisite: Consent of the instructor.
305. **Special Projects in Physical Education. 2 to 4 hours.** Independent research on special projects. Prerequisite: Approval of the student's project by a graduate faculty member.
306. **The Sport and Play of America. 4 hours.** The creation, importation, and derivation of sport and play in America; course of development and adaptation to the nature of American life; impact of the political, economic, cultural, and geographical scene on the character of sport and play. Special emphasis on sport and play in urban America. Prerequisite: History of physical education and/or sport.
313. **Curriculum Construction in Physical Education. 4 hours.** Principles of curriculum development and evaluation for physical education; analysis of age characteristics, needs, interests, and goals of students in a variety of community settings and their implication for the curriculum; development of psycho-motor behavioral objectives for curricular offerings for various learning groups. Prerequisite: Ed. 230.

## QUANTITATIVE METHODS

### Courses for Graduate and Advanced Undergraduate Students

- 370. Multivariate Analysis. 4 hours.** Theory and application of sampling from multivariate normal populations. Topics include such multivariate methods as multilinear regression, canonical correlation; analysis of variance and covariance; discriminant functions, structure of multivariate observations, both principal components and factor analysis. Prerequisites: QM 272, Math. 194 or 195, and Math. 348.
- 371. Survey Research. 4 hours.** Application of sampling theory and methods to planning, conducting, and evaluating surveys for measuring public opinion, consumer attitudes and preferences. Instruments of measurement, sample design estimation, sources of errors and bias. Case studies with application to actual situations. Prerequisite: QM 272 or the equivalent.
- 375. Information Systems. 4 hours.** An introduction to the theory and concepts of systems, including classification, deterministic and probabilistic models, Markov processes and Monte Carlo techniques, simulation. Introduction to the models as related to the computer; types of programming; experimentation and evaluation. Prerequisite: QM 272. Mathematics 194 or 195 is recommended.
- 376. Survey of Operations Research. 4 hours.** Methods, techniques, and applications; linear programming, simulation, production and inventory theory, queuing theory, game theory. Prerequisites: QM 272 and Math. 112.
- 378. Dynamic Programming. 4 hours.** Theory and application to solving problems in multistage decision processes arising in a wide variety of fields, such as operations research, engineering, and mathematics. Deterministic and random processes are considered, and computational and analytical methods of solution derived. Prerequisites: Math. 133 and 220 or the equivalents.

### Courses for Graduate Students

- 470. Mathematical Methods I. 4 hours.** Designed primarily to introduce and/or review areas of mathematics necessary for the development and understanding of the analytic tools students will encounter in subsequent courses of a Master in Business Administration program. Elementary set theory; mathematical functions; introduction to probability concepts; differential and integral calculus; series; functions of several variables. Prerequisites: Math. 110, 111, 112; QM 270, 271, 272.
- 471. Mathematical Methods II. 4 hours.** Sets and set functions; vector and matrix algebra; introduction to linear programming and game theory. At least one hour per week of laboratory in the use and application of digital computers and development in computer technology applicable to modern business operations. Prerequisites: Math. 110, 111, 112; QM 270, 271, and 272.

- 472. Statistics, Theory, and Applications. 4 hours.** Statistics and scientific method; uncertainty and probability, including Bayesian theory; binomial normal,  $t$ , Chi square, and  $F$  distributions; testing hypotheses and estimation; decision theory; analysis of variance, including regression and correlation; times series. Prerequisites: Math. 110, 111, 112; QM 270, 271, and 272.
- 473. Analysis of Variance and Experimental Design. 4 hours.** General theory of design and analysis of experiments. Least squares estimation, multiple regression, analysis of variance, randomization, randomized blocks, Latin squares, factorial designs, replication, incomplete blocks. Prerequisite: QM 472.
- 474. Statistical Decision Theory. 4 hours.** Hypothesis testing from the classical and Bayesian viewpoints with applications of probability to the making of decisions; some treatment of game strategy and its parallels in decision making. Prerequisite: QM 472.
- 475. Business Research and Forecasting. 4 hours.** The role of research in business, forecasting methods and techniques, including models and their applications. Prerequisite: QM 472.

## RUSSIAN

### Courses for Graduate and Advanced Undergraduate Students

- 320. Russian Poetry I. 4 hours.** Major poets from 1700 to 1840: Kantemir, Trediakovskij, Lomonosov, Sumarokov, Derzhavin, Fonvizin, Krylov, Pushkin, and others. Readings in Russian, discussion in English. Prerequisite: 24 hours of Russian.
- 321. Russian Poetry II. 4 hours.** Major poets from 1840 to the 1890's: Zukovskij, Batjuskov, Gnedic, Katenin, Odoevskij, Lermontov, Nekrasov, Plesceev, Tjutcev, Fet, and others. Readings in Russian, discussion in English. Prerequisite: 24 hours of Russian.
- 322. Russian Poetry III. 4 hours.** Major poets from the 1890's to the present: Merezhkovskij, Bal'mont, Sologub, Belyj, Blok, Axmatova, Mandel'stam, Esenin, Majakovskij, Pasternak, Tixonov, Simonov, Evtusenko, Voznesenskij, Rozdestvenskij, and others. Readings in Russian, discussion in English. Prerequisite: 24 hours of Russian.
- 324. Studies in Russian Literary Criticism. 4 hours.** Belinskij, Chernishevskij, Herzen, Dobrolyubov, Pisarev, L.N. Tolstoy. Prerequisite: Russ. 224.
- 332. Grammar for Teachers. 4 hours.** Intensive study and review of problems of Russian grammar and syntax. Prerequisite: Russ. 201.
- 350. Russian Novel I. 4 hours.** Historical and critical study of the development of the Russian novel from 1800 to about 1860: Pushkin, Lermontov, Gogol, Goncharov, Aksakov, Chernishevsky.



351. **Russian Novel II. 4 hours.** Continues Russian 350. Development from 1860 to about 1900: Turgenev, Alexey Tolstoy, Saltykov, Shchedrin, Lev Tolstoy, Dostoevsky, Leskov.
352. **Russian Novel III. 4 hours.** Continues Russian 351. Development from 1900 to the present: Gorkii, Sologub, Zamiatin, Fedin, Leonov, Pilniak, N. Ostrovskii, Sholokhov, A.N. Tolstoi, Ehrenburg, Dudintsev, Pasternak, Bulgakov, Solzhenitsyn. Prerequisite: 12 hours of Russian.
360. **Survey of Russian Drama. 4 hours.** Major authors from the beginning of the Enlightenment to the end of the nineteenth century: Sumarokov, Fonvizin, Ozerov, Griboyedov, Pushkin, Gogol, Turgenev, Ostrovsky, A. Tolstoy, L. Tolstoy, Chekhov, Gorky. Prerequisite: Russ. 224 or Spch. 122.

## SPANISH

### Courses for Graduate and Advanced Undergraduate Students

301. **Contemporary Spanish Poetry. 4 hours.** From Modernism to the present. Readings and interpretation of the works of some of the best known poets of the period. Prerequisite: Span. 219 or 221.
302. **Contemporary Spanish Theater. 4 hours.** Plays of some of the best known contemporary authors, from Benavente to Sastre. Prerequisite: Span. 219 or 221.
303. **Nineteenth Century Spanish Non-Romantic Drama. 4 hours.** Representative outlines of non-Romantic plays, their characteristics and development. Prerequisite: Span. 219 or 221.
305. **Spanish Romanticism. 4 hours.** Representative works of the Romantic period; particular emphasis on romantic drama and poetry. Prerequisite: Span. 219 or 221.
306. **Realism in Nineteenth Century Spanish Literature. 4 hours.** Continues Spanish 305. Prerequisite: Span. 219 or 221.
307. **The Generation of 1898. 4 hours.** Representative works of Baroja, Azorin, Unamuno, Maeztu, Valle Inclan, Benavente, A. Machado, and others. Prerequisite: Span. 219 or 221.
308. **Spanish-American Literature to 1888 I. 4 hours.** Development from the sixteenth century through the end of the Romantic period. Prerequisite: Span. 223 or 224 or the equivalent.
309. **Spanish-American Literature to 1888 II. 4 hours.** Continues Spanish 308. Prerequisite: Span. 223 or 224.
310. **Modernismo and Contemporary Spanish-American Poetry. 4 hours.** Spanish-American poetry from 1888 to the present, with some *Modernista* prose. Prerequisite: Span. 223 or 224.

311. *Modernismo* and Contemporary Spanish-American Poetry. 4 hours. Continues Spanish 310. Prerequisite: Span. 223 or 224.
314. Poetry of the Golden Age. 4 hours. The development of Spanish lyric poetry out of both popular and classical sources. *Romances*, Renaissance poetry, mystic poetry, *culturanoismo*, and *conceptismo*. Prerequisite: Span. 218.
315. Drama of the Golden Age. 4 hours. Development of Spanish theater in the Golden Age; detailed study of plays by Lope de Vega, Tirso de Molina, Calderon, and other representative dramatists. Prerequisite: Span. 218.
317. Prose of the Golden Age. 4 hours. Major examples of picaresque, pastoral, and chivalric forms. Prerequisite: Span. 218.
318. Minor Works of Cervantes. 4 hours. The prose of Cervantes and its relationship to his masterpiece. Prerequisite: Span. 218.
319. *Don Quijote*. 4 hours. Reading and discussion; emphasis on novelistic technique and development of the novel. Prerequisite: Span. 218.
320. The Contemporary Spanish Novel. 4 hours. The novel as it has developed since 1936. Prerequisite: Span. 219 or 221.
321. The Contemporary Spanish Novel. 4 hours. Continues Spanish 320. Prerequisite: Span. 219 or 221.
323. The Contemporary Spanish-American Novel I. 4 hours. From the Romantic period to 1930. Prerequisite: Span. 224 or the equivalent.
324. The Contemporary Spanish-American Novel II. 4 hours. Continues Spanish 323. From 1930 to the present. Prerequisite: Span. 223 or 224.
340. History of the Spanish Language. 4 hours. General survey of the development of the Spanish language. Prerequisite: Consent of the instructor.
342. Introduction to Romance Philology. 4 hours. History of the Romance languages, especially Spanish, French, Italian, and Portuguese, from the classical Latin period to the present; their external history, phonology, morphology, and syntax. Prerequisite: Consent of the instructor.
345. Medieval Spanish Literature. 4 hours. Important works from the beginnings to 1400. Prerequisite: Span. 218. Spanish 340 is recommended.
346. Medieval Spanish Literature. 4 hours. Important works of the fifteenth century. Prerequisite: Span. 218. Spanish 340 is recommended.
349. Phonetics. 4 hours. Prerequisites: Span. 213, and 218 or 221.
371. Spanish for Teachers. 4 hours. Consideration of those language problems suggested by teaching experience. It is recommended that this course be taken

after student teaching, in the last quarter before graduation. Also open to experienced teachers. Prerequisite: Student teaching or professional teaching experience.

390. **Topics in Spanish Literature. 6 hours.** May be repeated. Topics vary from quarter to quarter. Prerequisite: Consent of the instructor.
399. **Independent Study. 1 to 6 hours.** Supervised study in an area not covered by regularly offered courses, under the direction of a faculty member designated at the discretion of the department on the request of a qualified student. Individual conferences, assigned readings and papers, and other work are required. Prerequisites: Spanish major or graduate student in Spanish with senior standing and approval of the department.

## Courses for Graduate Students

407. **Seminar: Galdos. 6 hours.** Individual conferences on course papers are required. Detailed study of Galdos' novelistic art; emphasis on *Fortunata y Jacinta* and other works illustrative of his major periods. Prerequisite: Span. 306.
440. **The Spanish Renaissance. 6 hours.** Social, cultural, and intellectual characteristics; main periods and aspects in relation to typical authors and works from 1450 to 1600. Prerequisite: At least two of the following courses: Span. 314, 315, 317, 318, 319, 345, 346.

## SYSTEMS ENGINEERING

### Courses for Graduate and Advanced Undergraduate Students

307. **Cybernetics I. 4 hours.** Same as Information Engineering 307. Introduction to artificial intelligence and pattern recognition by computer. Programs for playing games, proving theorems, answering questions, and making medical diagnosis. Property selection and decisionmaking techniques. Prerequisites: Math. 195 and either 250 or 370.
311. **Introduction to Systems Analysis I. 4 hours.** Mathematical modeling of systems described by ordinary differential equations, including electrical, mechanical, economic, ecological, industrial, and others. Fundamental laws describing generalized system elements. Topological consequences of element interconnections and solutions for elementary topologies using computer methods. Prerequisites: Math. 195 and InfE. 210.
312. **Introduction to Systems Analysis II. 4 hours.** Continues Systems Engineering 311. Lagrange's methods of deriving generalized system equations. Analysis of multiloop topologies using vector matrix forms. Solution of the general linear system using Laplace transforms and computer techniques. Prerequisite: SysE. 311.
313. **Introduction to Systems Analysis III. 4 hours.** Continues Systems Engineering 312. Feedback, stability, and frequency characteristics of generalized linear

systems. Matrix transfer function forms for interacting systems. Introduction to nonlinear generalized systems. Prerequisite: SysE. 312.

321. **Distributed Systems Analysis. 4 hours.** Analysis of linear, one and two-dimensional distributed parameter systems arising in engineering, economics, industry, and transportation type systems. Equations of motion are derived from elementary differential models and analyzed using analytic and simulation techniques. Prerequisite: SysE. 311 or the equivalent.
325. **Nonlinear Systems Analysis. 4 hours.** Analysis of inherently and/or topologically nonlinear models arising in engineering, economic, and ecological systems. Energy methods are used to reduce topology to a state space model which is then analyzed using classical and computer aided techniques. Prerequisite: SysE. 313 or the equivalent.
326. **Discrete Systems Analysis. 4 hours.** Analysis of the equations of motion of physical system models using finite difference forms. Lumped linear and nonlinear systems are emphasized but, where applicable, method is extended to distributed systems. Prerequisite: SysE. 313 or the equivalent.
330. **Transportation Systems Analysis II. 3 hours.** Examination of technological components and relationships affecting the performance of transportation systems; integrated analysis of system performance and its effects on the economic, political, and psychological aspects of human activities. Prerequisites: SysE. 230 and credit or registration in Econ. 120.
331. **Transportation Systems Engineering. 3 hours.** Examination of fundamental physical relationships governing the operation and design of transportation systems and their components; general and specific function of component specifications and system design. function of component specificaitons and system design. Prerequisites: SysE. 330 and MatE. 102 or Phys. 111.
332. **Transportation Systems Planning. 3 hours.** Philosophies, strategies, and specific analytical techniques for planning large transportation systems; analysis and critique of contemporary institutional structures and models used for transportation planning; general and specific methods of forecasting future needs, developing plans, and evaluating alternatives; application of various techniques to practical transportation planning problems. Prerequisite: SysE. 330.
340. **Analysis and Design of Systems I. 4 hours.** Open to a limited number of advanced undergraduate and graduate social science students. Introduction to strategic and tactical procedures for applying a variety of analytic techniques to large-scale systems; emphasis on the interaction of these systems with society. In addition to readings, lectures, and discussions, student teams undertake comprehensive design projects to gain realistic experience with analysis and design procedures. Prerequisite: Consent of the instructor. For social science students; senior standing in their fields, background in algebra, geometry, and calculus equivalent to Math. 110 through 112, and consent of the instructor.



350. **Stochastic Processes. 4 hours.** Analysis of probabilistic systems; the theory of games and decisions; recurrent event models, Markov processes, and queuing systems; digital computer simulation of stochastic processes; applications to specific engineering systems. Prerequisite: Math. 370.
352. **Experimental Design. 4 hours.** Review of fundamental concepts of statistical analysis. Introduction to standard experimental designs and their associated application in the statistical interpretation of research data and design of engineering systems. Completely random designs, randomized block designs, Latin squares, covariance analysis, and factorial experiments.
355. **Urban Systems Analysis II. 3 hours.** Introduction to the analysis of dynamic urban systems; urban process analysis; modeling of growth and development processes; studies of decentralized and centralized decisional systems; quantitative analysis techniques for modeling; evaluating the performance of existing and planned urban and regional systems and components; analysis and evaluation of technologically based regional policies. Prerequisites: SysE. 240 and credit or registration in Econ. 120.
356. **Urban Systems Planning. 3 hours.** Introduction to philosophies, theories, strategies, and techniques of urban systems planning; studies of urban value systems and the development of operational planning objectives; planning information systems, data collection and analysis; predictive model development; plan design methods; analysis of resources allocation; plan testing and evaluation; application of specific techniques to laboratory problems. Prerequisites: Econ. 120, SysE. 355.
360. **Traffic Flow and Control Systems. 3 hours.** Introduction to particular flow systems; investigation of microscopic flow relations and their effect on macroscopic flow properties; generalized study of traffic control systems; integrated investigation of flow properties, control systems, and system safety characteristics; applications to highway and air traffic flow. Laboratory work in data collection, analysis, and simulation studies. Prerequisites: Math. 195, 370.
361. **Evaluation of Engineering Systems. 2 hours.** Strategies and techniques for evaluating complex urban and transportation systems; discussion of public works investment-decision processes and the role of the engineer; economic, social, psychological, and political analysis of major engineering systems; market studies and simulation techniques; cost-effectiveness studies and program budgeting systems. Prerequisites: Econ. 120, SysE. 230 or 240.
371. **Optimization Techniques I. 4 hours.** Linear programming models, Simplex method, sensitivity analysis, transportation problems, duality. Nonlinear programming models, separable objective function, geometric programming, Kuhn-Tucker equations, quadratic programming. Prerequisites: Math. 195 and 220.
372. **Optimization Techniques II. 4 hours.** Dynamic programming. Optimal control theory; Bellman, Hamilton-Jacobi, and Euler-Lagrange equations; Pontryagin's maximum principle. Search techniques, golden mean and Fibonacci search, gradient approach, stochastic approximation. Prerequisite: SysE. 371.

- 380. Quantitative Methods in Urban Engineering.** 3 hours. Theory and application of fundamental statistical and mathematical techniques of measurement and data analysis for urban systems engineering; presentation and critical review of selected quantitative methods appropriate to identifying problems, establishing design standards and evaluating the performance of urban engineering systems. Prerequisites: Math. 195, 370, and SysE. 230 or 240.
- 381. Projects in Urban Systems Engineering.** 2 hours. Analytical and experimental projects in urban systems engineering and planning. Prerequisites: SysE. 380 and credit or registration in SysE. 350.
- 391. Seminar.** 1 to 4 hours. May be repeated. Topics to be arranged. Prerequisite: Consent of the instructor.
- 393. Special Problems.** 2 to 4 hours. Special problems or reading by arrangement with the faculty. Prerequisite: Consent of the instructor.

## Courses for Graduate Students

- 411. Systems Theory I.** 4 hours. Linear systems theory: state equations formulation, transform methods, structural properties, stability, observability, and controllability. Linear stochastic systems. Prerequisites: SysE. 313 and 370.
- 412. Systems Theory II.** 4 hours. General systems theory: observability, controllability, and stability for systems described by nonlinear, partial and differential-difference equations. Prerequisites: SysE. 321, 325, 326, and 411.
- 413. Differential Games and Applications.** 4 hours. Differential game theory as applied to mathematical models of socioeconomic and urban type systems. Optimal strategies are obtained as functions of the state variables, and computer simulations are used to determine optimal trajectories. Prerequisites: SysE. 372 and 412.
- 440. Analysis and Design of Systems II.** 4 hours. Continues Systems Engineering 340. Detailed studies of strategies and tactics for analyzing and designing large-scale, complex engineering systems. Student teams formulate and exercise analytic and predictive models of engineering systems and their interaction with their environments. Prerequisite: SysE. 340.
- 450. Applied Stochastic Processes.** 4 hours. The stochastic nature of queues, inventories, and engineering reliability. Comprehensive analysis of queueing systems, Markov chains, and inventory models; engineering analysis of reliability problems. Prerequisite: SysE. 350.
- 451. Decision Theory.** 4 hours. Introduction to the mathematical analysis of decision making when the state of the world is uncertain but further information about it can be obtained by experimentation. Formal consideration of the decision maker's knowledge about the application; utility theory. Relation between Bayesian and traditional statistical decision theory. Prerequisite: SysE. 350.

455. **Urban Information Systems. 4 hours.** The fundamental informational bases of urban system and subsystem structure, operations, and decision and control; cybernetic urban models, functional aspects of information systems, and operational examples of formalized systems; design of specialized planning information systems, including the establishment and fulfillment of information requirements. Prerequisite: SysE. 356.
460. **Theory of Transportation Networks. 4 hours.** Establishment of a mathematical basis for network flows and the relation of this basis to combinatorial analysis and graph theory. Consideration of static and dynamic maximal flows, multi-terminal flows, and multi-commodity flows. Application of these techniques to such other problems as the trim problem, the warehousing problem, and the allocation-location problem. Prerequisites: SysE. 332 and 372.
471. **Mathematical Programming in Industrial Systems. 4 hours.** Consideration of mathematical programming as applied to functional areas of business and industry; review of status of operations research in major industries. Prerequisite: SysE. 372.
472. **Stochastic Optimization. 4 hours.** Development of algorithms which optimize mathematical models involving random variables for coefficients and/or restrictions. Consideration of changes necessary in linear programming and dynamic programming methods that allow handling of stochastic problems. Effect of underlying stochastic processes on nature of solution. Prerequisites: SysE. 350 and 372.
475. **Seminar in Advanced Topics in Optimization. 2 to 4 hours.** May be repeated. In-depth treatment of individual optimization techniques; emphasis on current research. Topics for each quarter will be announced. Prerequisite: Consent of the instructor.
495. **Individual Research. 2 to 4 hours.** May be repeated for a maximum of 12 hours. Research on special problems not included in graduate-thesis. Prerequisite: Consent of the instructor.
498. **Seminar in Systems Engineering. 2 to 4 hours.** May be repeated for a maximum of 12 hours. Systematic treatment of special topics; emphasis on current research. Prerequisite: Consent of the instructor.
499. **Graduate Thesis. 0 to 16 hours.** May be repeated. Thesis work under the supervision of a graduate adviser. Prerequisite: Consent of the adviser.



## ADDITIONAL FACULTY OF THE GRADUATE COLLEGE

The following faculty have graduate standing and teach in departments that presently offer graduate-level courses but not graduate degrees.

Gyan C. Agarwal, Ph.D., Associate Professor of Systems Engineering  
Rene Amon, Ph.D., Associate Professor of Architecture  
Basil T. Argeropolus, Instructor in Art  
Eliezer B. Ayal, Ph.D., Professor of Economics

Jean H. Baer, Ph.D., Professor of Education  
Hale C. Bartlett, Ph.D., Associate Professor of Management  
Bernard H. Baum, Ph.D., Professor of Management  
Amin Beck, Ph.D., Associate Professor of Education  
Leon Bellin, M.A., Associate Professor of Art  
Edmund Bender, Ph.D., Assistant Professor of French  
Violet Bergquist, M.A., Associate Professor of Spanish  
Nancy D. Berryman, Ed.D., Associate Professor of Art  
Eduardo Betoret-Paris, Ph.D., Associate Professor of Spanish  
Manuel Blanco-Gonzalez, M.A., Associate Professor of Spanish  
Alvin S. Boyarsky, M.R.P., Professor of Architecture  
Joseph Braga, Ed.D., Assistant Professor of Education  
Lucille V. Braun, Assistant Professor of Spanish  
George Bugliarello, Sc.D., Professor of Systems Engineering

Patricia S. Charlier, Ph.D., Associate Professor of Education  
Priscilla P. Clark, Ph.D., Assistant Professor of French  
Edwin Cohen, Ph.D., C.P.A., Professor of Accounting  
Yehoshua S. Cohen, M.A., Instructor in Geography  
James D. Compton, Ph.D., Assistant Professor of Spanish  
Peter V. Conroy, Ph.D., Assistant Professor of French  
Leonard J. Currie, M.Arch., Professor of Architecture  
Alden D. Cutshall, Ph.D., Professor of Geography

Dragomir V. Davidovich, Ph.D., Professor of Criminal Justice  
Edward L. Deam, M.Arch., Professor of Architecture  
Horst de la Croix, Ph.D., Professor of History of Architecture and Art  
Lucile Derrick, Ph.D., Professor of Quantitative Analysis  
Rheta De Vries, Ph.D., Assistant Professor of Education  
Edwin H. Draine, Ph.D., Associate Professor of Geography  
Elliott Dudnik, M.S.C.E., Professor of Architecture  
Brian Dutton, Ph.D., Professor of Spanish

Maurice Eash, Ed.D., Professor of Education  
Ruth Elsaffar, Ph.D., Assistant Professor of Spanish  
Bert E. Elwert, Ph.D., Associate Professor of Economics and Management  
Frederick D. Erickson, Ph.D., Assistant Professor of Education



Lawrence P. Feldman, Ph.D., Associate Professor of Marketing  
Mildred I. Finney, Ph.D., Associate Professor of Geography  
Sheldon L. Fordham, Ed.D., Professor of Physical Education for Men  
Samuel Fox, Ph.D., Professor of Accounting

Charles B. Genther, B.S., Lecturer in Architecture  
Robert W. Gerstner, Ph.D., Professor of Architecture  
George C. Giles, Jr., Ph.D., Associate Professor of Education  
Dorothy F. Gillanders, Ed.D., Professor of Physical Education for Women  
Roland F. Ginzler, M.F.A., Professor of Art  
Brian Gluss, Ph.D., Professor of Quantitative Methods  
William D. Grampp, Ph.D., Professor of Economics  
Andrew Greeley, Ph.D., Professor of Education  
Peter W. Gygax, *Dipl. Arch.*, Associate Professor of Architecture

Robert E. Hallowell, Ph.D., Professor of French  
Donald D. Hanson, M.Arch., Professor of Architecture  
Helen M. Heitmann, D.P.E., Professor of Physical Education for Women  
George A. Hinds, M.C.P., Professor of Architecture  
S. George Huneryager, Ph.D., Professor of Management  
Martin Hurtig, M.S., Professor of Art

Ronald Jablonski, D.B.A., Associate Professor of Management  
Joseph Jachna, M.S., Assistant Professor of Art  
Jerald W. Jackard, M.A., Associate Professor of Art  
T. Robert Jaeger, M.Arch., Associate Professor of Architecture  
Thomas M. Johnson, J.D., Ph.D., Professor of Economics

Milan R. Kaderavek, D.M.A., Associate Professor of Music  
William M. Kaplan, D.M.A., Associate Professor of Music  
Hinman L. Kealy, M.C.P., Associate Professor of Architecture  
Leonard D. Kent, Ph.D., Professor of Quantitative Methods  
Howard F. Koeper, Ph.D., Professor of History of Architecture and Art  
Richard Koppe, Professor of Art  
Richard F. Kosobud, Ph.D., Professor of Economics  
Eliezer Krumbein, Ph.D., Associate Professor of Education

Carol LaBranche, Ph.D., Assistant Professor of History of Architecture and Art  
Albert J. Larson, Ph.D., Assistant Professor of Geography  
Marie E. Lein, Ph.D., Professor of French  
Charles M. Lombard, Ph.D., Professor of French

Charles Mader, Ed.D., Assistant Professor of Education  
Joseph J. Malinchoc, Ed.D., Associate Professor of Education  
Alfonse Malinosky, M.B.A., C.P.A., Professor of Accounting  
Alfred P. Maurice, M.A., Professor of Art

Donald M. McIntyre, L.L.D., Associate Professor of Criminal Justice  
 John D. McNee, M.A., Professor of History of Architecture and Art  
 George Megarefs, Ph.D., Professor of Architecture  
 Henry L. Mikolayczyk, M.Arch., Professor of Architecture  
 Floyd G. Miller, Ph.D., Assistant Professor of Systems Engineering  
 Barbara G. Mittman, Ph.D., Assistant Professor of French  
 George Monroe, Ph.D., Associate Professor of Education  
 June Moravcevic, Ph.D., Assistant Professor of French  
 Nicholas Moravcevic, Ph.D., Professor of Comparative Literature  
 Van Cleve Morris, Ed.D., Professor of Education  
 Ronald P. Moses, M.B.A., Assistant Professor of Economics  
 Robert W. Nickle, B.A., Professor of Art  
 Joseph Nicol, M.S., Professor of Criminal Justice  
 Nancy L. Nihan, Ph.D., Assistant Professor of Systems Engineering  
 Richard E. Norton, Ph.D., Assistant Professor of Music

Lawrence B. Ocai, Ph.D., Assistant Professor of Physical Education for Men  
 James W. Osterburg, M.P.A., Visiting Professor of Criminal Justice

Kenneth I. Perry, Ph.D., Associate Professor of French  
 Elizabeth Pribic, Ph.D., Associate Professor of Slavic Languages

Jerry Rank, Ph.D., Assistant Professor of Spanish  
 Robert H. Ratcliffe, Ph.D., Associate Professor of Education  
 Victor E. Ricks, Ph.D., Professor of Education  
 Robert Rippey, Ph.D., Associate Professor of Education  
 Louis Rocah, M.S., Associate Professor of Architecture  
 Bradley L. Rothmel, Ph.D., Associate Professor of Physical Education for Men

Lalitha Sanathanan, Ph.D., Assistant Professor of Quantitative Methods  
 Jose Sanchez, Ph.D., Professor of Spanish  
 Samuel Sandler, Ph.D., Associate Professor of Slavic Languages  
 Hans K. Schaal, M.S., Assistant Professor of Art  
 Stephen A. Schiller, J.D., Associate Professor of Criminal Justice  
 Mary J. Schlinger, Ph.D., Assistant Professor of Marketing  
 William M. Schuyler, Ph.D., Professor of French  
 Madelaine M. Shalabi, Ph.D., Associate Professor of Education  
 Sol S. Shalit, M.B.A., Assistant Professor of Economics  
 Sherman Shapiro, Ph.D., Professor of Economics  
 Leonard D. Singer, M.S., Assistant Professor of Art  
 David M. Solzman, Ph.D., Associate Professor of Geography  
 Siim Soot, Ph.D., Assistant Professor of Geography  
 Houston H. Stokes, M.A., Assistant Professor of Economics  
 Frederick G. Stubbs, Jr., Ph.D., Assistant Professor of Finance  
 Roland Q. Swaim, Ed.D., Assistant Professor of Education  
 Franklin P. Sweetser, Ph.D., Associate Professor of French  
 Marie-Odile Sweetser, Ph.D., Associate Professor of French

Harriet Talmage, Ph.D., Assistant Professor of Education  
Charles A. Tesconi, Jr., Ed.D., Assistant Professor of Education  
Guenther Tetz, M.F.A., Assistant Professor of Art  
Dorothy R. Thelander, Ph.D., Associate Professor of French  
Edwin N. Thomas, Ph.D., Professor of Geography  
Clifford E. Tiedemann, Ph.D., Associate Professor of Geography  
Larry L. Tifft, M.A., Assistant Professor of Criminal Justice  
Stanley M. Tigerman, M.Arch., Professor of Architecture  
William W. Tongue, Ph.D., Professor of Economics and Finance  
Judith Torney, Ph.D., Professor of Education

Nicholas J. Valenziano, M.M.Ed., Assistant Professor of Music

Edward W. Walbridge, Ph.D., Assistant Professor of Systems Engineering  
John E. Walley, Professor of Art  
John A. Webster, Ph.D., Associate Professor of Criminal Justice  
Robert E. Weigand, Ph.D., Professor of Marketing  
Roger G. Whitmer, M.S., Associate Professor of Architecture  
Frederick P. Wiesinger, Ph.D., Professor of Architecture

# Index

- Academic work loads for assistants, 23
- Accounting, courses in, 170
- Administration of criminal justice,
  - courses in, 171
- Admission, 16
- Advanced Degrees
  - time limitations for, 21
- Advisers, 21
- Anthropology, Department of, 11, 44
  - admission requirements, 44
  - courses, 45, 47
  - degree requirements, 44
- Application procedures, 17
- Architecture, courses in, 173
- Art-Design, courses in, 174
- Assistantships, 35
- Auditing privileges, 23
- Bioengineering 11, 96, 175
- Biological Sciences, Department of,
  - 11, 49
  - admission requirements, 49
  - courses, 50, 54
- Business law, courses in, 175
- Chemistry, Department of, 11, 58
  - admission requirements, 59
  - courses, 60, 62
  - degree requirements
    - Master of Science, 59
    - Doctor of Philosophy, 60
- Computer Center, 40
- Counseling, educational vocational,
  - personal, 42
- Course loads, 22
- Dean of Men, Dean of Women, 41
- Deferred-Fee charge, 31
- Degrees, regulations pertaining to
  - Master's, 24
  - Doctoral, 24
  - Foreign language requirement for, 25
  - Examinations, 25
  - Thesis, 26
- Drop rules, 22
- Economics, courses in, 175
- Education, courses in, 177
- Employment, 38
- Energy Engineering, Department of,
  - 11, 64
  - courses, 66, 67
  - degree requirements
    - Master of Science, 65
    - Doctor of Philosophy, 65
- English, Department of, 11, 71
  - admission requirements, 71
  - courses, 75, 79
  - degree requirements,
    - M.A. in English, 73
    - in linguistics, 74
- Executive Committee of the Graduate College, 13
- Fees, 30
- Fellowship holders, 23
- Fellowships, 33
  - University, 34
  - industrial, endowed, and special, 34
- Finance, courses in, 180
- Foreign applicants, 17
- Foreign Student Affairs, Office of, 43
- French, courses in, 181
- Full-time study, minimum for, 23
- Geography, courses in, 185
- Geological Sciences, Department of,
  - 11, 81
  - admission requirements, 81
  - courses, 82, 83
  - degree requirements, 82
- German, Department of, 11, 84
  - admission requirements, 85
  - courses, 85, 86
  - degree requirements, 85
- Grading system, 22
- Graduate credit for work completed elsewhere, 20
- Graduate study by seniors, 16
- Greek, courses in, 188
- Health Service, University, 42
- History, Department of, 12, 88
  - admission requirements, 88
  - courses, 91, 93
  - degree requirements
    - Master of Arts, 88



- Master of Arts Program for teachers, 89
- Doctor of Philosophy, 90
- History of architecture and art, courses in, 189
- Housing Office, 40
- Information Engineering**, Department of, 11, 95
  - admission requirements, 95
  - bioengineering, 96
  - courses 97, 99
  - Master of Science, 95
- Insurance, Hospital-Medical-Surgical, 30
- Laboratory facilities**, 41
- Late registration, fine for, 30
- Latin, courses in, 191
- Leaves of absence for graduate students, 18
- Library, 39
- Linguistics, courses in, 191
- Loans, 37
  - Illinois guaranteed, 38
  - short-term emergency, 38
- Location and transportation, campus, 15
- Lost photo—identification—card fee, 31
- Management**, courses in, 194
- Marketing, courses in, 198
- Materials Engineering**, Department of, 11, 103
  - admission requirements, 103
  - courses, 105, 108
  - degree requirements
    - Master of Science, 104
    - Doctor of Philosophy, 104
- Mathematics**, Department of, 12, 111
  - admission requirements, 112
  - courses, 114, 119
  - degree requirements
    - Doctor of Philosophy, 113
    - Master of Arts, Master of Science, 112
    - Master of Science in Teaching, 112
- Music, courses in, 199
- National Science Foundation**, traineeships, 34
- Off-quarter vacations**, 19
- Organizations and activities, 43
- Petitions**, 20
- Philosophy**, Department of, 12, 125
  - admission requirements, 125
  - courses in, 126, 128
  - degree requirements, 125
- Phonetic-Linguistic Research Laboratory, 41
- Physical education, courses in, 200
- Physics**, Department of, 12, 130
  - courses in, 132, 134
  - degree requirements, 131
- Placement Services, 43
- Political Science**, Department of, 12, 137
  - courses in, 138, 142
  - degree requirements, 137
- Probation rules, 22
- Psychology**, Department of, 12, 143
  - admission requirements, 143
  - courses in, 145, 147
  - degree requirements, 144, 145
- Quantitative Methods**, courses in, 201
- Readmission**, 18
- Refunds, withdrawal, 31
- Registration, 18
- Residence classification, 28
- Service fee**, 29
- Social Work**, Jane Addams Graduate School of, 12, 152
  - admission requirements, 152
  - courses in, 154
  - degree requirements, 153
  - joint programs with McCormick Theological Seminary, 153
  - program at Chicago Circle, 154
- Sociology**, Department of, 12, 159
  - admission requirements, 160
  - courses in, 161, 164
    - Doctor of Philosophy in, 160
    - Master of Arts in, 160
- Russian**, courses in, 202
- Spanish**, courses in, 203
- Speech and Hearing Clinic, 42
- Speech and Theater**, Department of, 12, 165
  - admission requirements, 165
  - courses in, 166, 168
  - degree requirements, 166
- Student affairs, 41
- Student Counseling Service, 42
- Systems engineering**, courses in, 205
- Thesis**, doctoral, requirements for, 26
- Traineeships, NSF, 34
- Transcript fee, 31
- Tuition and fees**, 27
  - deposit, 27
  - residence classification for, 28
  - exemptions and assessments, 28
  - waiver holders, 23
- Tuition-and-fee waivers**, 36
  - how to apply, 36
  - announcement of awards, 36
  - payment of nonresident portion of, 29
- Visitor-Auditor fee**, 30
- Work completed elsewhere**, credit for, 20



FOR USE IN  
READING ROOM ONLY



UNIVERSITY OF ILLINOIS-URBANA



3 0112 110343073

LIBRARIAN  
UNIV OF ILLINOIS

URBANA ILL

61801